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Prescription d'exercice en prévention primaire et secondaire: Entraînement par intervalles à haute intensité pour tous?

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Déclaration du conférencier (Patrice Brassard)

Je déclare n'avoir aucun conflit d'intérêt en relation avec cette activité.

L'exercice est la meilleure pilule qui existe sur le marché

REVIEWS

PHYSIOLOGY 28: 330–358, 2013; doi:10.1152/physiol.00019.2013

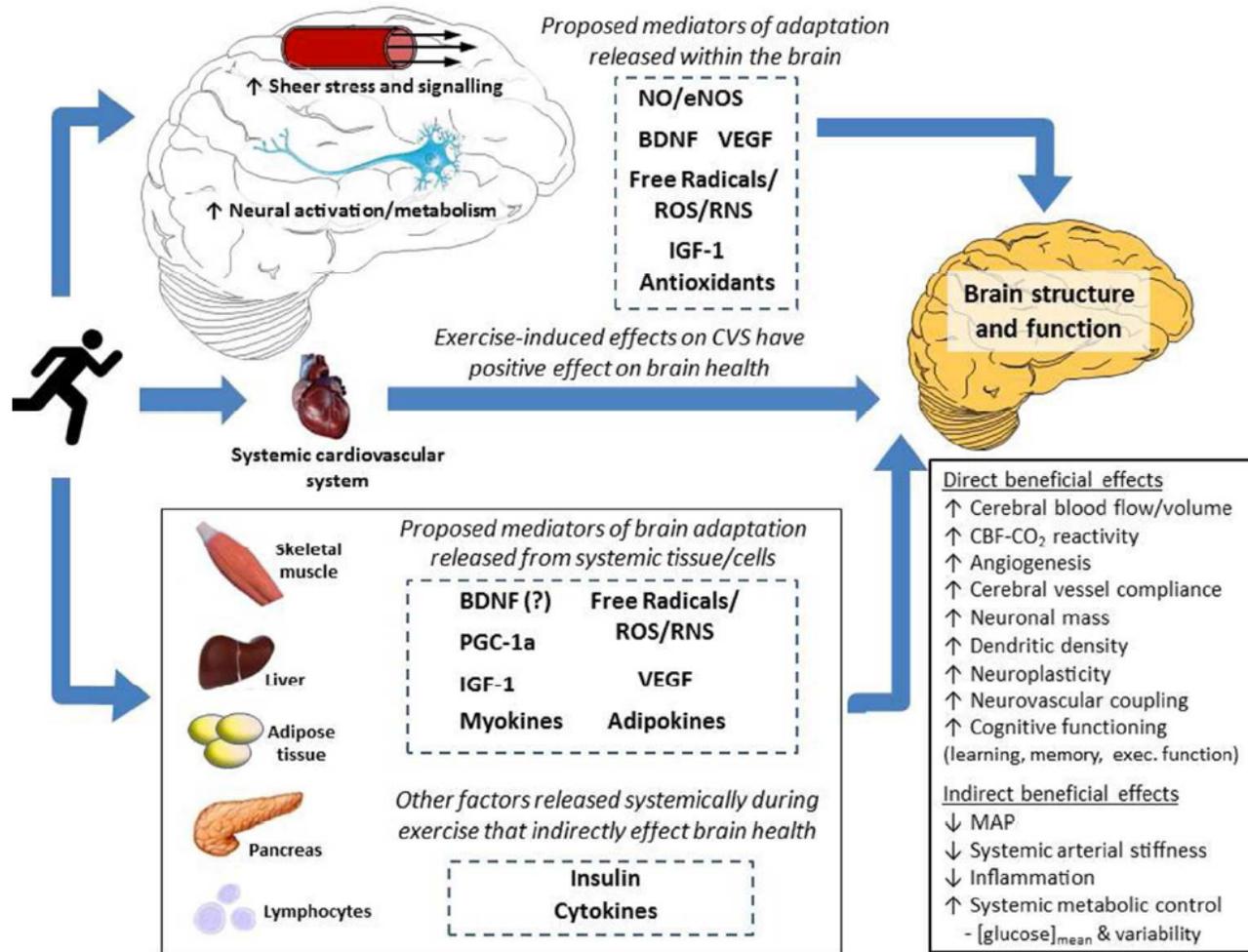
Exercise is the Real Polypill

The concept of a “polypill” is receiving growing attention to prevent cardiovascular disease. Yet similar if not overall higher benefits are achievable with regular exercise, a drug-free intervention for which our genome has been haped over evolution. Compared with drugs, exercise is available at low cost and relatively free of adverse effects. We summarize epidemiological evidence on the preventive/therapeutic benefits of exercise and on the main biological mediators involved.

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L'exercice est la meilleure pilule qui existe sur le marché



Bénéfices de l'exercice sur les facteurs de risques cardiaques



Table 1. Effect of Exercise Training on Cardiac Risk Factors

Risk Factor	Effect(s)
Diabetes mellitus	Meta-analysis of exercise programs in diabetic patients demonstrates mean decrease in hemoglobin A1C of 0.8% ⁶
Dyslipidemia	Meta-analysis of exercise programs demonstrated a mean increase in high-density lipoprotein of 2.5 mg/dL ⁷
Hypertension	Meta-analysis of exercise programs demonstrated a reduction in blood pressure of 3.4/2.4 mm Hg ⁸
Cigarette smoking	An exercise program resulted in higher levels of abstinence from smoking at 3 and 12 months ⁹
Obesity	Lifestyle modification including exercise resulted in a mean 6.7-kg weight loss at 1 year ¹⁰
Psychosocial health	A program of cardiac rehabilitation resulted in significant decreases in depression, anxiety, hostility, somatization, and psychosocial stress ¹¹

Prescription traditionnelle d'exercice

Table 2 Exercise training prescription generally applicable

Mode	Continuous endurance: walking, jogging, cycling, swimming, rowing, stair climbing, elliptical trainers, and aerobic dancing
Duration	At least 20–30 min (preferably 45–60 min)
Frequency	Most days (at least 3 days/week and preferably 6–7 days/week)
Intensity	50–80% of peak oxygen consumption (close to anaerobic threshold) or of peak heart rate or 40–60% of heart rate reserve; 10/20–14/20 of the Borg Rating of Perceived Exertion

A progressive increasing training regimen should be prescribed with regular follow-up controls (at least every 3–6 months), to adjust the duration and the level of the exercise to the reached level of tolerance.

Peak oxygen consumption (Peak VO_2) by cardiopulmonary exercise testing is the ideal physiologic marker of intensity: practically surrogate intensity markers are here presented.

L'entraînement par intervalles à haute intensité (HIIT) est très populaire...pas seulement chez les athlètes !

Physiological Reports

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Physiological Reports ISSN 2051-817X

ORIGINAL RESEARCH

A 3-week multimodal intervention involving high-intensity interval training in female cancer survivors: a randomized controlled trial

Joachim Schmitt¹, Nathalie Lindner², Monika Reuss-Borst¹, Hans-Christer Holmberg^{3,4} & Billy Sperlich²

Diabetologia (2016) 59:56–66
DOI 10.1007/s00125-015-3741-2



ARTICLE

High intensity intermittent exercise improves cardiac structure and function and reduces liver fat in patients with type 2 diabetes: a randomised controlled trial

Sophie Cassidy^{1,3} • Christian Thoma¹ • Kate Hallsworth^{1,3} • Jehill Parikh^{1,2} • Kieren G. Hollingsworth^{1,2} • Roy Taylor^{1,2} • Djordje G. Jakovljevic^{1,3} • Michael I. Trenell^{1,2,3}

Design and rationale of the HITS randomized controlled trial: Effect of High-intensity Interval Training in de novo Heart Transplant Recipients in Scandinavia

Kari Nytrøen, PhD,^{a,b} Marianne Yardley, MD,^{a,b} Katrine Rolid, MSc,^a Elisabeth Bjørkelund, BSc,^a Kristjan Karason, PhD,^c Julia Philip Wigh, MSc,^c Christian Have Dall, PhD,^d Satish Arora, PhD,^a Svend Aakhus, PhD,^a Ketil Lunde, PhD,^a Ole Geir Solberg, PhD,^a Finn Gustafsson^e Eva Irene Bossano Prescott^d and Lars Gullestad^{a,b} *Oslo, Norway; Gothenburg, Sweden; and Copenhagen, Denmark*

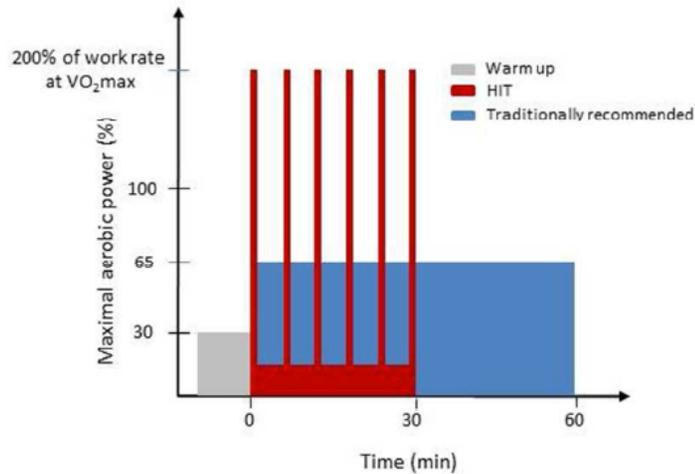


Exercise Physiology

Superior Cardiovascular Effect of Aerobic Interval Training Versus Moderate Continuous Training in Heart Failure Patients A Randomized Study

Ulrik Wisløff, PhD; Asbjørn Støylen, MD, PhD; Jan P. Loennechen, MD, PhD; Morten Bruvold, MSc; Øivind Rognmo, MSc; Per Magnus Haram, MD, PhD; Arnt Erik Tjønnå, MSc; Jan Helgerud, PhD; Stig A. Slørdahl, MD, PhD; Sang Jun Lee, PhD; Vibeke Videm, MD, PhD; Anja Bye, MSc; Godfrey L. Smith, PhD; Sonia M. Najjar, PhD; Øyvind Ellingsen, MD, PhD; Terje Skjærpe, MD, PhD

Différents types de HIIT



HIIT

- 6 x 30 sec 'all-out' sur vélo – 4,5 min récupération active
- 3 x / semaine

Entraînement aérobic continu (CONT)

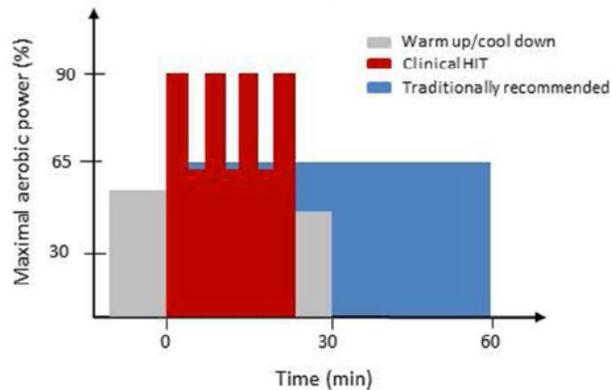
- Exercice continu d'intensité modérée
- 60 min
- 5 x / semaine

HIIT vs. CONT

Volume par semaine: ↓ 90%

Investissement temps: 1/3

Burgomaster et al. J Physiol 586(1): 151-60, 2008



HIIT clinique

- Intervalles de 4 min à 85-95% FCmax – 3 min récupération active
- 3 x / semaine

HIIT clinique vs. CONT

- ↓ Pression artérielle
- Amélioration contrôle glycémique
- ↑ Capacité aérobie
- ≠ Effets indésirables

Lucas, Cotter, Brassard and Bailey JCBFM 35(6):902-11, 2015

Weston et al. Br J Sports Med 48(16):1227-34, 2014

Bénéfices associés à l'entraînement HIIT

Table 1. Cardiac and noncardiac effects of high-intensity interval training

Cardiac effects

- Improved VO_2 peak
- Improved endothelial function
- Improved blood pressure
- Improved sympathovagal balance
- Improved cardiac remodelling
- Improved natriuretic peptide levels
- Improved cardiometabolic profile
- Improved adherence to exercise training?

Noncardiac effects

- Improved mobility and gait
 - Improved functional capacity
 - Improved quality of life
 - Improved cognition
-

VO_2 , oxygen uptake.

Devrions-nous prescrire du HIIT à tous les patients ?

High-Intensity Interval Training for Patients With Cardiovascular Disease—Is It Safe? A Systematic Review

Michael A. Wewege, BExPhys;* Dohee Ahn, BExPhys;* Jennifer Yu, MBBS; Kevin Liou, PhD; Andrew Keech, PhD

Background—Cardiac rehabilitation (CR) for patients with cardiovascular disease has traditionally involved low- to moderate-intensity continuous aerobic exercise training (MICT). There is growing and robust evidence that high-intensity interval training (HIIT) shows similar or greater efficacy compared with MICT across a range of cardiovascular and metabolic measures, in both healthy populations and populations with a chronic illness. However, there is understandable concern about the safety aspects of applying HIIT in CR settings. This systematic review analyzed safety data drawn from recent proof-of-concept studies of HIIT during CR among patients with cardiovascular disease.

Methods and Results—We included trials comparing HIIT with either MICT or usual care in patients with coronary artery disease or heart failure participating in tertiary care services, such as phase 2 (outpatient) CR. Adverse events occurring during or up to 4 hours after an exercise training session were collated. There were 23 studies included, which analyzed 1117 participants (HIIT=547; MICT=570). One major cardiovascular adverse event occurred in relation to an HIIT session, equating to 1 major cardiovascular event per 17 083 training sessions (11 333 training hours). One minor cardiovascular adverse events and 3 noncardiovascular adverse events (primarily musculoskeletal complaints) were also reported for HIIT. Two noncardiovascular events were reported in relation to MICT.

Conclusions—HIIT has shown a relatively low rate of major adverse cardiovascular events for patients with coronary artery disease or heart failure when applied within CR settings. (*J Am Heart Assoc.* 2018;7:e009305. DOI: 10.1161/JAHA.118.009305.)

Key Words: cardiac rehabilitation • exercise • exercise capacity • exercise training • safety

Mais...l'exercice à haute intensité n'est pas sans risque

[HOME](#) > [NEWS](#) > [CELEBRITY NEWS](#)

Andrew Marr's stroke caused by intense exercise

Andrew Marr has revealed that the stroke that almost killed him was caused by work-out on rowing machine, as the BBC presenter warns against intense exercise.



Andrew Marr made his first television appearance after his stroke on his show in April Photo: screen grab

Devrions-nous prescrire du HIIT à tous les patients ?

thus potentially resulting in improved adherence to exercise training. For these reasons, we and other groups believe HIIT should be considered in all patients enrolled in a CR program.^{48,69} Ongoing clinical trials by others⁸⁰ and us should help confirm the longer-term safety and efficacy of this training modality.

Juneau et al. Can J Cardiol 30: S401-S409, 2014

Implications du HIIT pour la santé vasculaire cérébrale ?

Est-ce que le HIIT représente un danger pour le cerveau?

Efficacité du HIIT au niveau cardiaque et métabolique

- Modèles animaux
- Sujets sains
- Populations cliniques

Patients avec pathologies cérébrales

- Utilisation de protocoles HIIT sans preuves scientifiques sur efficacité vasculaire cérébrale

Est-ce que le HIIT représente un danger pour le cerveau?

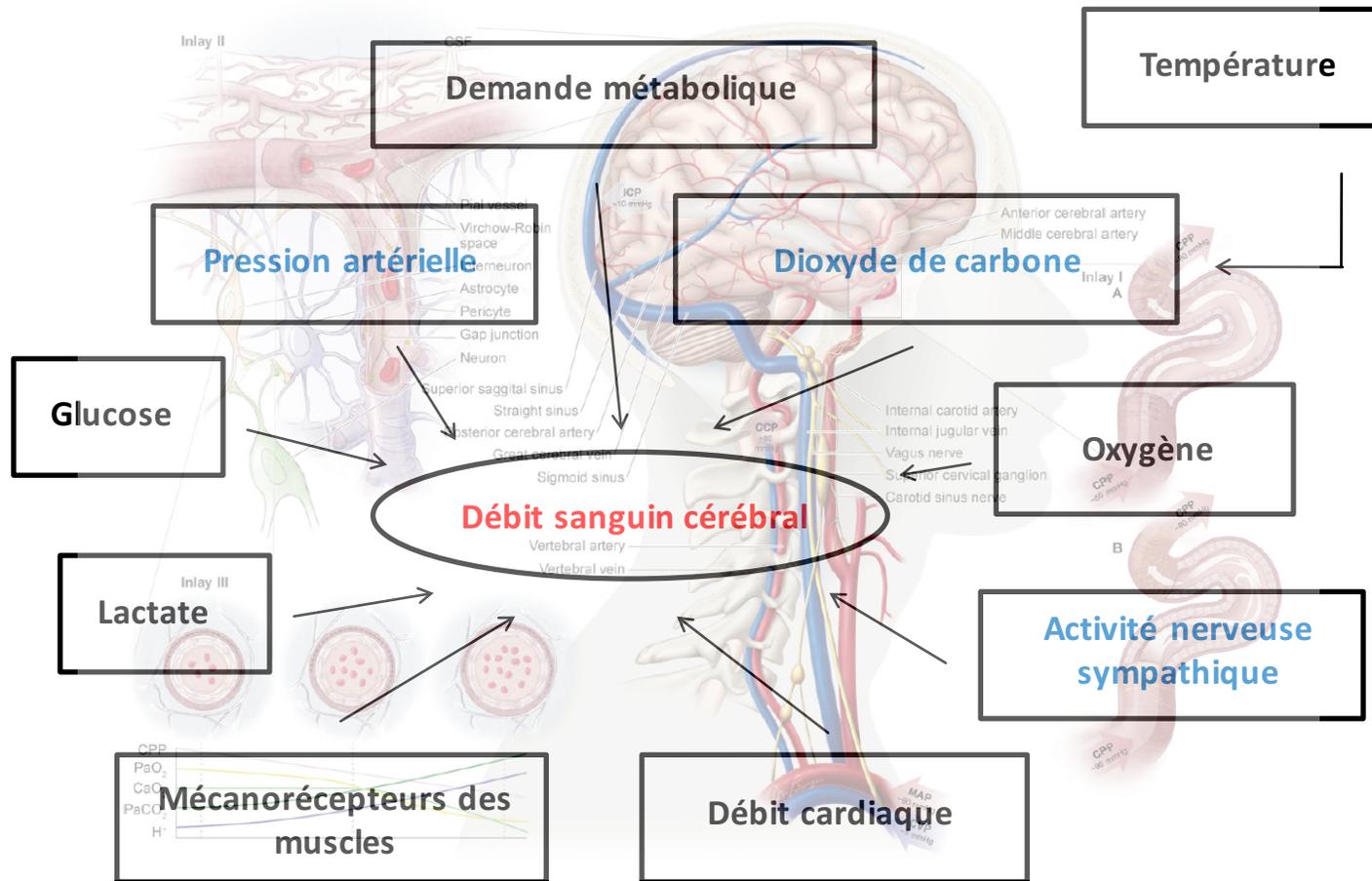
Pas d'effets indésirables – réadaptation post-AVC

- Pas d'événement en 294 heures de HIIT chez 41 patients AVC

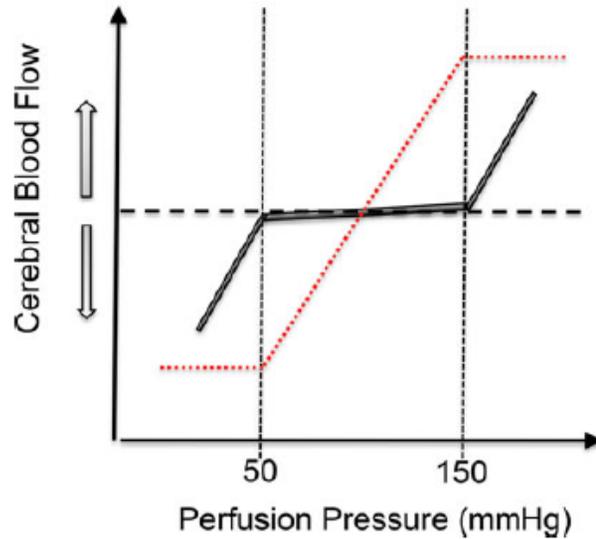
Peu d'études nous permettant de tirer des conclusion concernant l'implantation clinique du HIIT

- Post-AVC
- Pathologies liées au cerveau

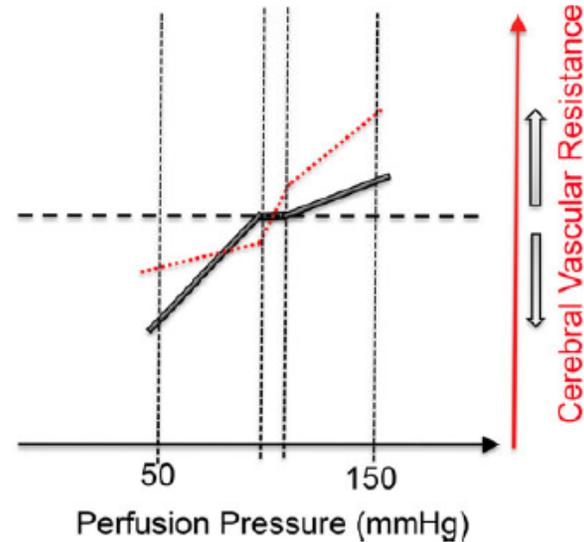
Est-ce que le HIIT est risqué pour le cerveau?



Autorégulation cérébrale dynamique



Willie CK et al. J Physiol 592.5: 841-859, 2014

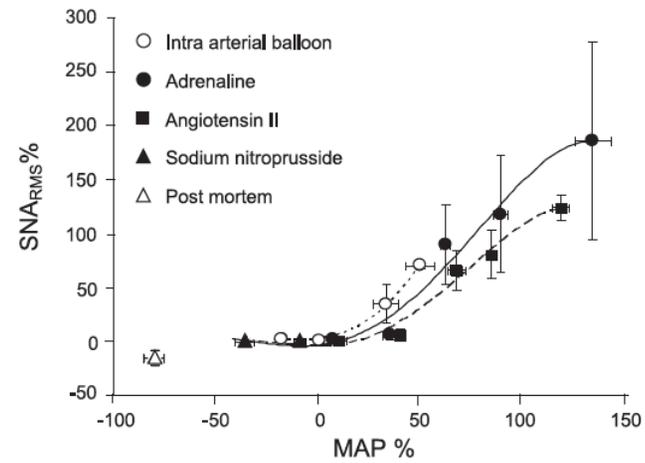
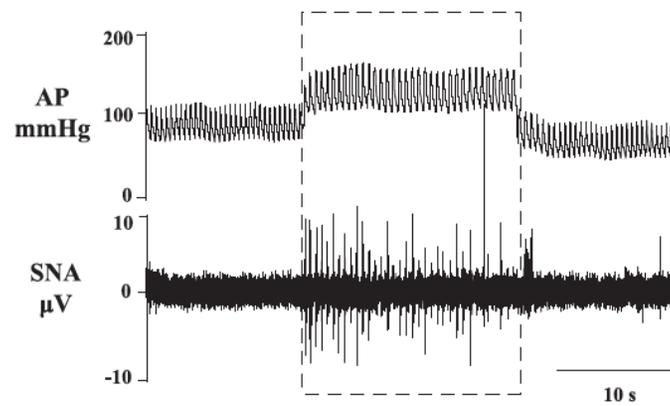
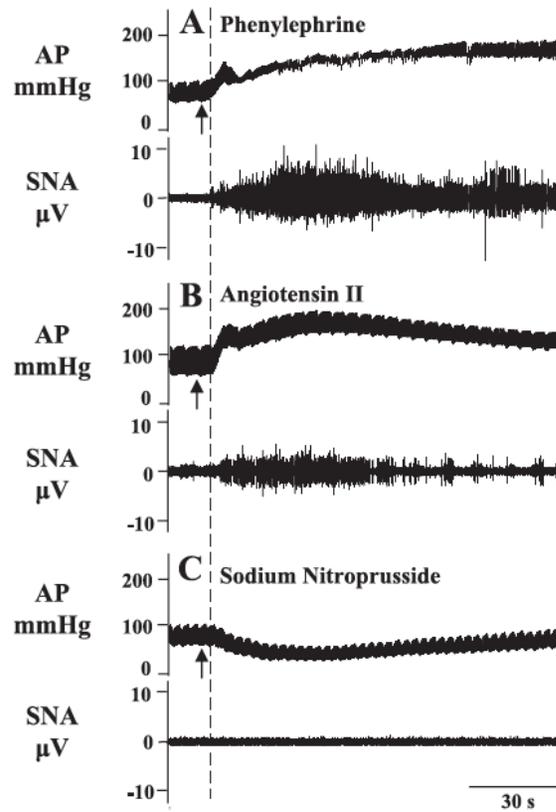


Tzeng and Ainslie Eur J Appl Physiol 114(3):545-559, 2013

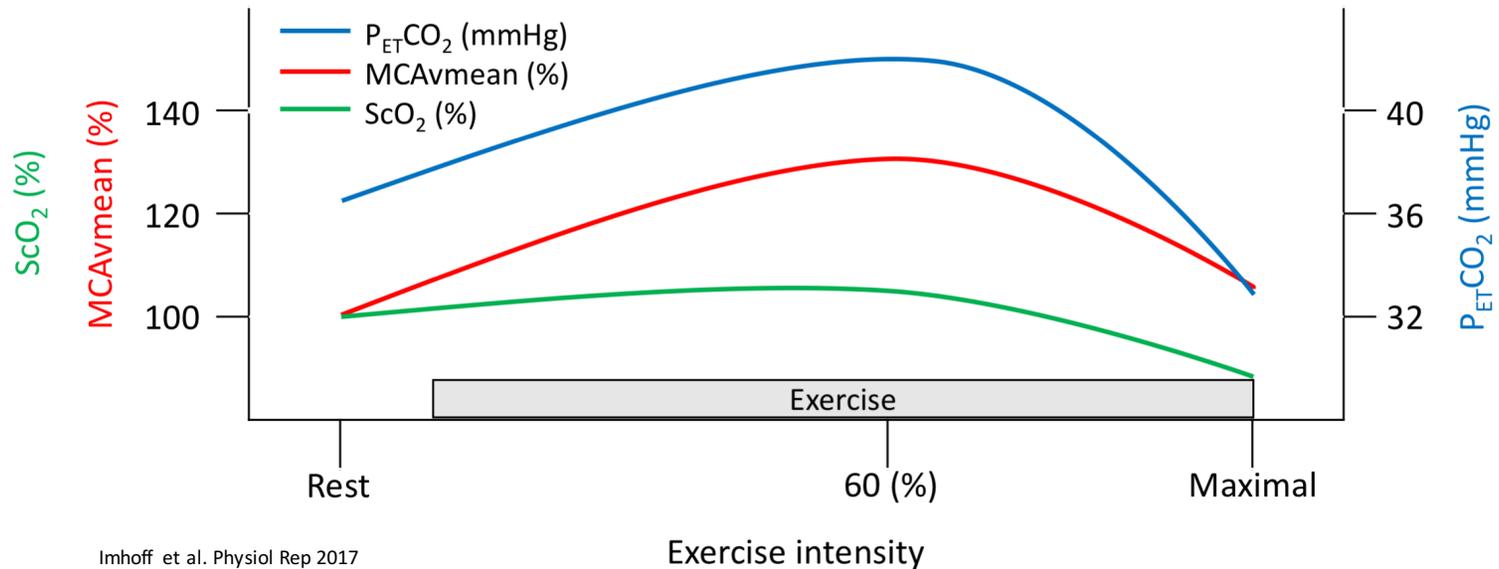
Changements soudains de pression artérielle moyenne sont transmit directement à la circulation cérébrale, mais le débit sanguin cérébral tend à retourner à sa valeur de base à l'intérieur d'un bref instant

Les mécanismes rapides permettant la restauration du débit sanguin cérébral après des changements aigus de pression artérielle représentent l'autorégulation cérébrale dynamique

Activité nerveuse sympathique



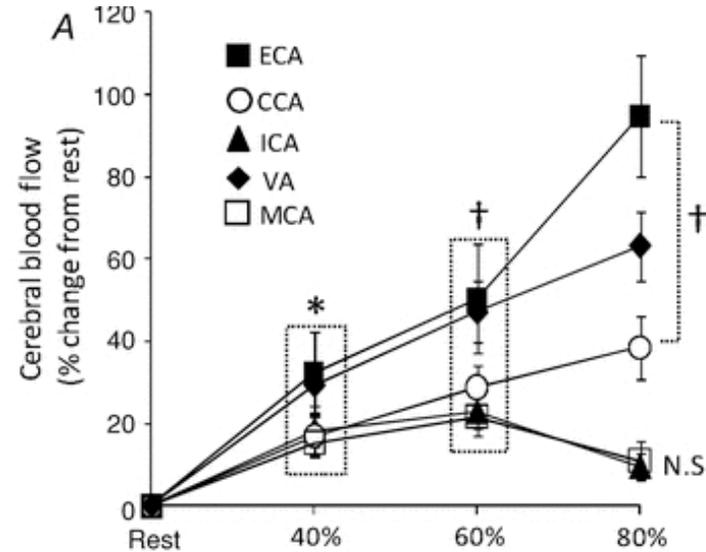
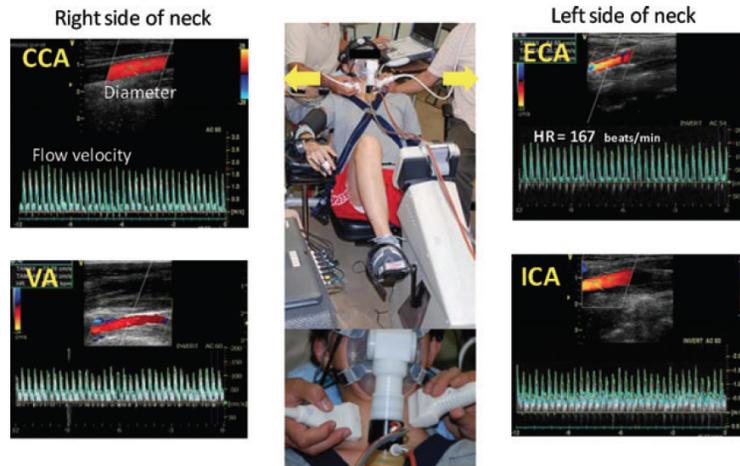
Vasoconstriction induite par l'hypocapnie



Effet bénéfique hypocapnie et vasoconstriction cérébrale - effort intense

- Neuroprotection: éviter rupture BBB/blessures associées hyperperfusion?
- Associées a une meilleure régulation CBF durant changements PAM
- Suffisant pour contrer augmentation perfusion cérébrale induite par le HIIT?

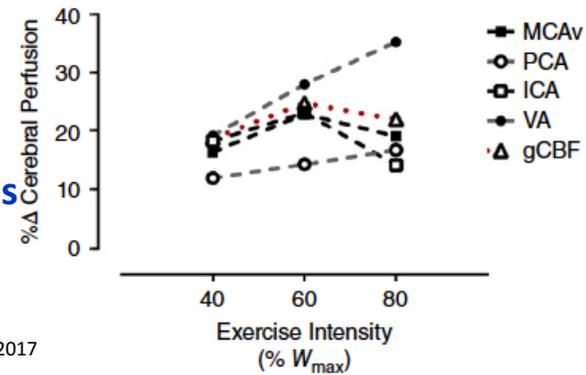
Pour compliquer le tableau...



Différences régionales

- Distribution DSC à l'exercice
- Autorégulation cérébrale
- Réactivité vasculaire cérébrale au CO₂
- Activité du système nerveux sympathique

Régions alimentées par les artères vertébrales plus susceptibles aux blessures induites par une hyperperfusion



Est-ce que le HIIT représente un danger pour le cerveau?

Augmentations soudaines pression artérielle

- Autorégulation cérébrale
- Activité sympathique (cérébrale ?)
- Réactivité vasculaire cérébrale au dioxyde de carbone

Blessures induites par hyperperfusion cérébrale prédisposant...

- Accident vasculaire cérébral
- Altérations barrière hémato-encéphalique (BBB)

Donc...est-ce que le HIIT est risqué pour le cerveau?

Physiological Reports

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ORIGINAL RESEARCH

Physiological Reports ISSN 2051-817X

Diminished dynamic cerebral autoregulatory capacity with forced oscillations in mean arterial pressure with elevated cardiorespiratory fitness

Lawrence Labrecque^{1,2}, Kevan Rahimaly^{1,2}, Sarah Imhoff^{1,2}, Myriam Paquette^{1,2}, Olivier Le Blanc^{1,2}, Simon Malenfant^{1,2}, Samuel J. E. Lucas^{3,4}, Damian M. Bailey^{5,6} , Jonathan D. Smirl⁷ & Patrice Brassard^{1,2} 

Physiological Reports

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ORIGINAL RESEARCH

Physiological Reports ISSN 2051-817X

Dynamic cerebral autoregulation is attenuated in young fit women

Lawrence Labrecque^{1,2}, Kevan Rahimaly^{1,2}, Sarah Imhoff^{1,2}, Myriam Paquette^{1,2}, Olivier Le Blanc^{1,2}, Simon Malenfant^{1,2}, Audrey Drapeau^{1,2}, Jonathan D. Smirl³, Damian M. Bailey⁴  & Patrice Brassard^{1,2} 



Physiological Reports

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ORIGINAL RESEARCH

Physiological Reports ISSN 2051-817X

Six weeks of high-intensity interval training to exhaustion attenuates dynamic cerebral autoregulation without influencing resting cerebral blood velocity in young fit men

Audrey Drapeau^{1,2}, Lawrence Labrecque^{1,2}, Sarah Imhoff^{1,2}, Myriam Paquette^{1,2}, Olivier Le Blanc^{1,2}, Simon Malenfant^{1,2} & Patrice Brassard^{1,2} 



Am J Physiol Heart Circ Physiol 317: H685–H694, 2019.
First published July 26, 2019; doi:10.1152/ajpheart.00196.2019.

RESEARCH ARTICLE | *Integrative Cardiovascular Physiology and Pathophysiology*

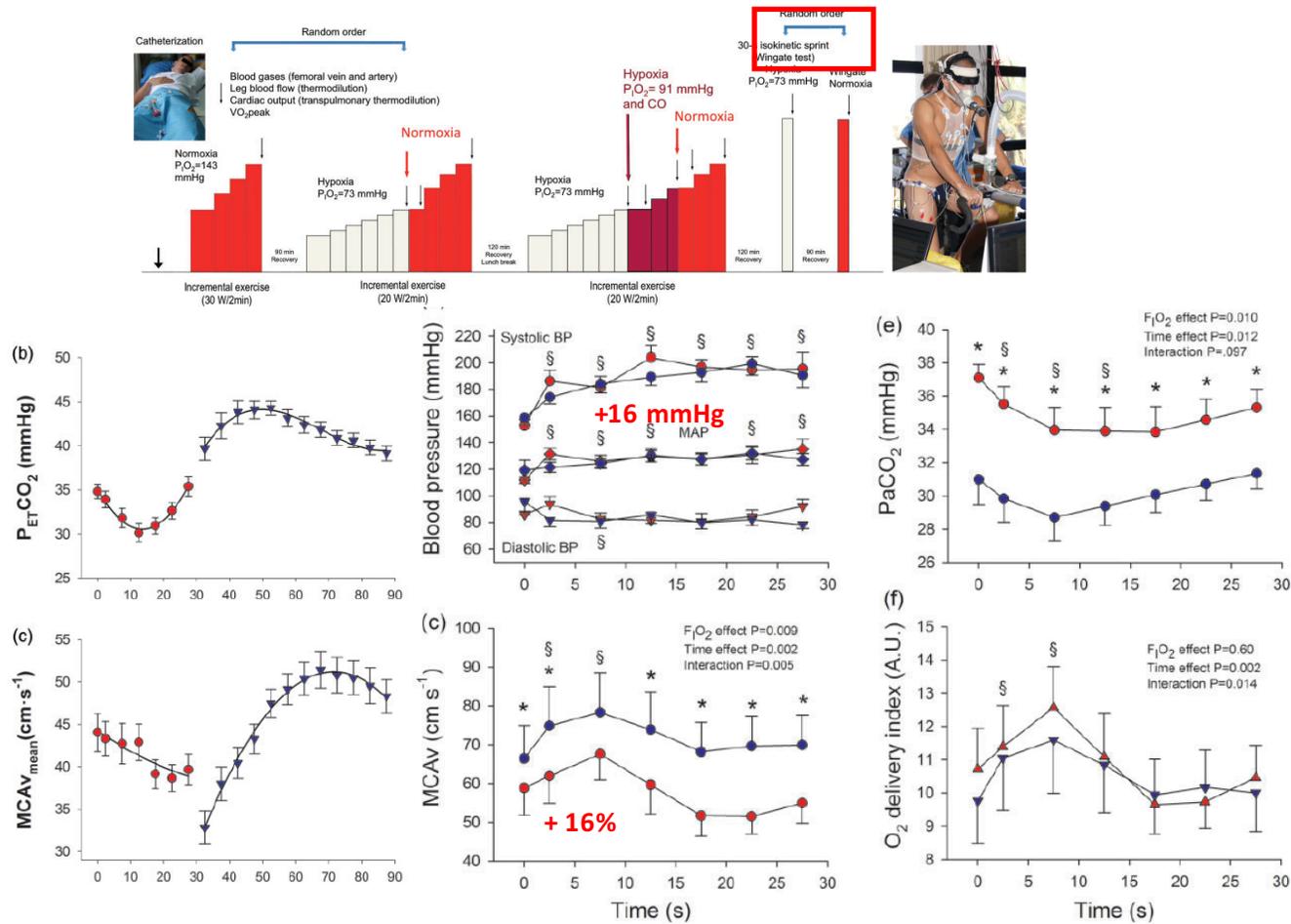
Cardiac remodeling after six weeks of high-intensity interval training to exhaustion in endurance-trained men

Haïfa Mahjoub,¹ Olivier Le Blanc,^{2,3} Myriam Paquette,^{2,3} Sarah Imhoff,^{2,3} Lawrence Labrecque,^{2,3} Audrey Drapeau,^{2,3} Paul Poirier,^{3,4} Élisabeth Bédard,³ Philippe Pibarot,^{1,3} and  Patrice Brassard^{2,3}
¹Department of Medicine, Université Laval, Québec, Canada; ²Department of Kinesiology, Faculty of Medicine, Université Laval, Québec, Canada; ³Research Center of the Institut Universitaire de Cardiologie et de Pneumologie de Québec, Québec, Canada; and ⁴Faculty of Pharmacy, Université Laval, Québec, Canada

Submitted 25 March 2019; accepted in final form 24 July 2019

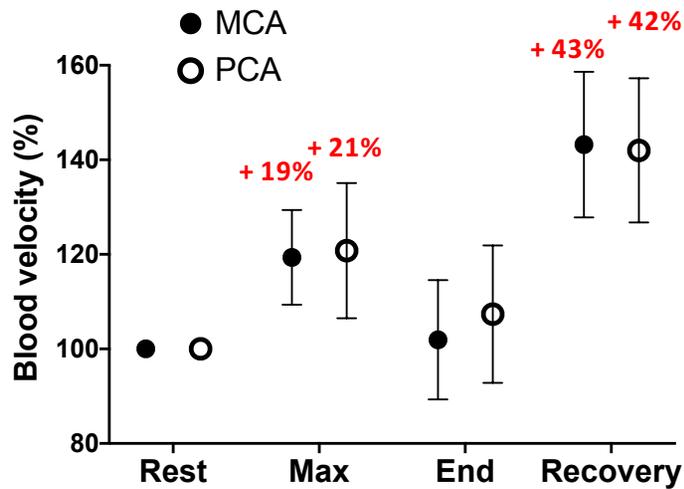
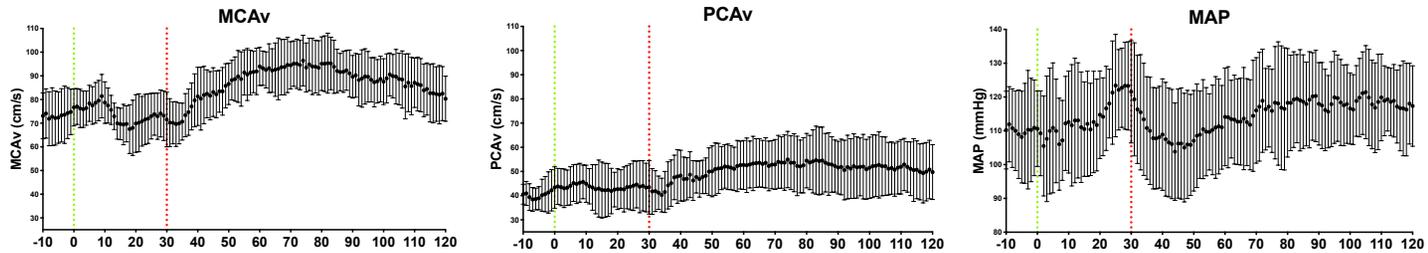


HIIT et débit sanguin cérébral chez des hommes sains

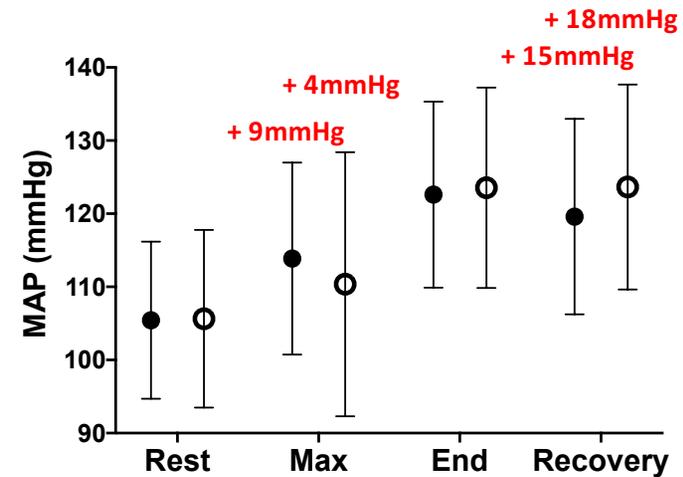


Curtelin et al. JCBFM 2017

HIIT et débit sanguin cérébral chez des femmes saines



Time effect: $P < 0.0001$



Time effect: $P < 0.0001$

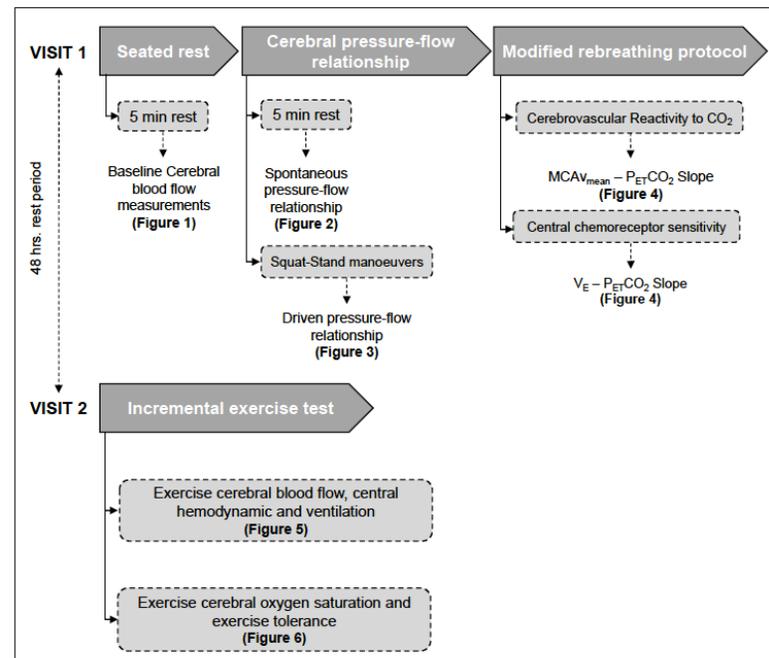
Caractérisation de la fonction vasculaire cérébrale avant l'entraînement HIIT

ORIGINAL RESEARCH



Compromised Cerebrovascular Regulation and Cerebral Oxygenation in Pulmonary Arterial Hypertension

Simon Malenfant, PhD;* Patrice Brassard, PhD;* Myriam Paquette, MSc; Olivier Le Blanc, MSc; Audrey Chouinard, BSc; Valérie Nadeau, PhD; Philip D. Allan; Yu-Chieh Tzeng, MBChB, PhD; Sébastien Simard, PhD; Sébastien Bonnet, PhD; Steve Provencher, MD, MSc



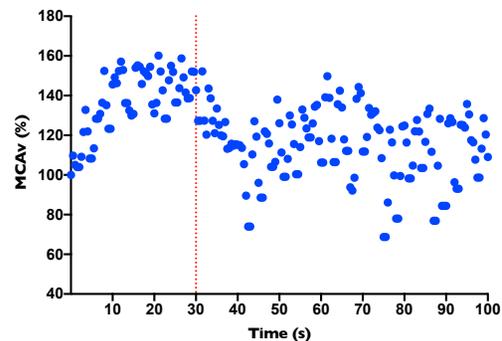
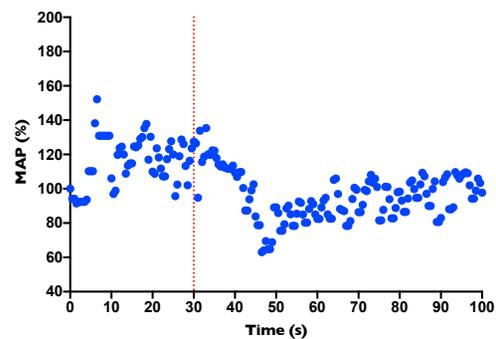
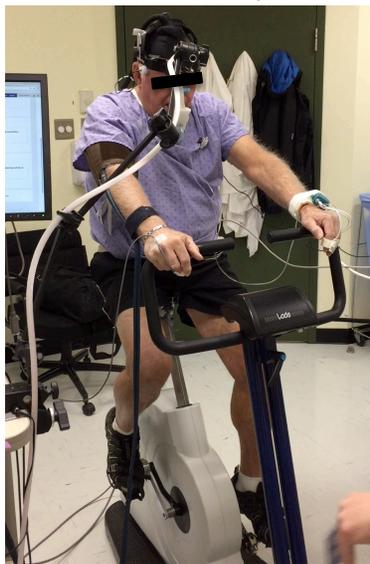
Malenfant, Brassard et al. JAHA 6:e006126, 2017

HIIT et débit sanguin cérébrale: maladie vasculaire périphérique

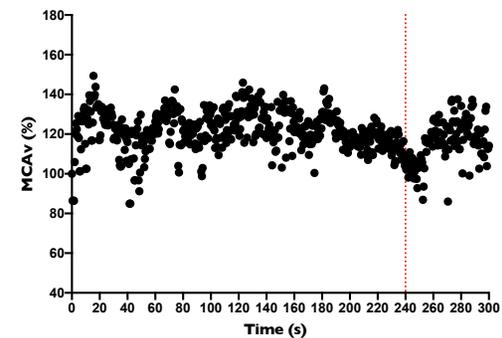
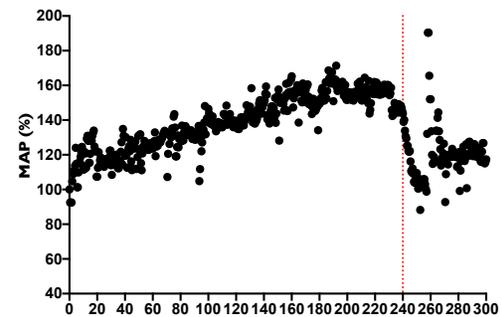
1) Caractérisation de la fonction vasculaire cérébrale + HIIT aigu



Lawrence Labrecque



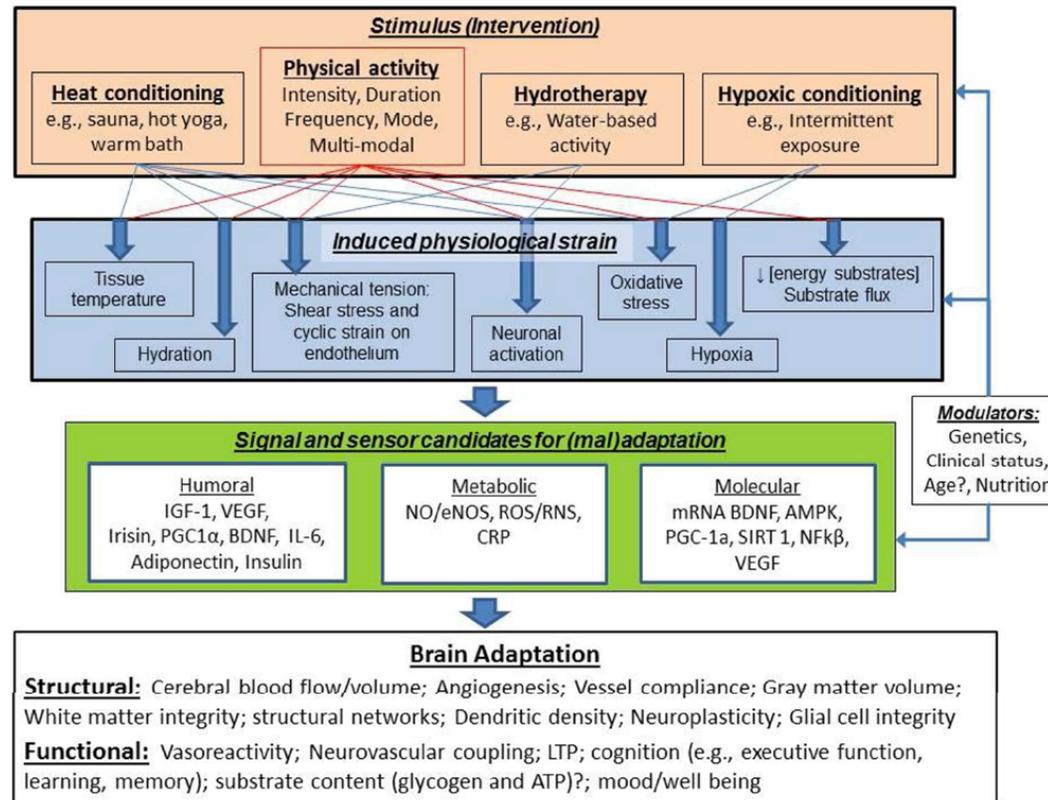
30 s at maximal workload



4 min at 85% maximal workload

2) 12 semaines de HIIT

Différentes options pour optimiser la réponse des vaisseaux du cerveau à l'exercice



Donc...HIIT pour tous?

- 1. Exercice aigu/chronique est bénéfique pour plusieurs fonctions du corps humain**
- 2. Individus sains/athlètes vs. patients**
- 3. Besoin d'examiner l'hémodynamie cérébrale durant et après l'entraînement HIIT de manière plus approfondie chez les patients ayant des mécanismes neuroprotecteurs moins efficaces**
- 4. Faire attention à la façon dont le HIIT est prescrit**