

5^{ème} Forum Européen *Cœur Exercice et Prévention*



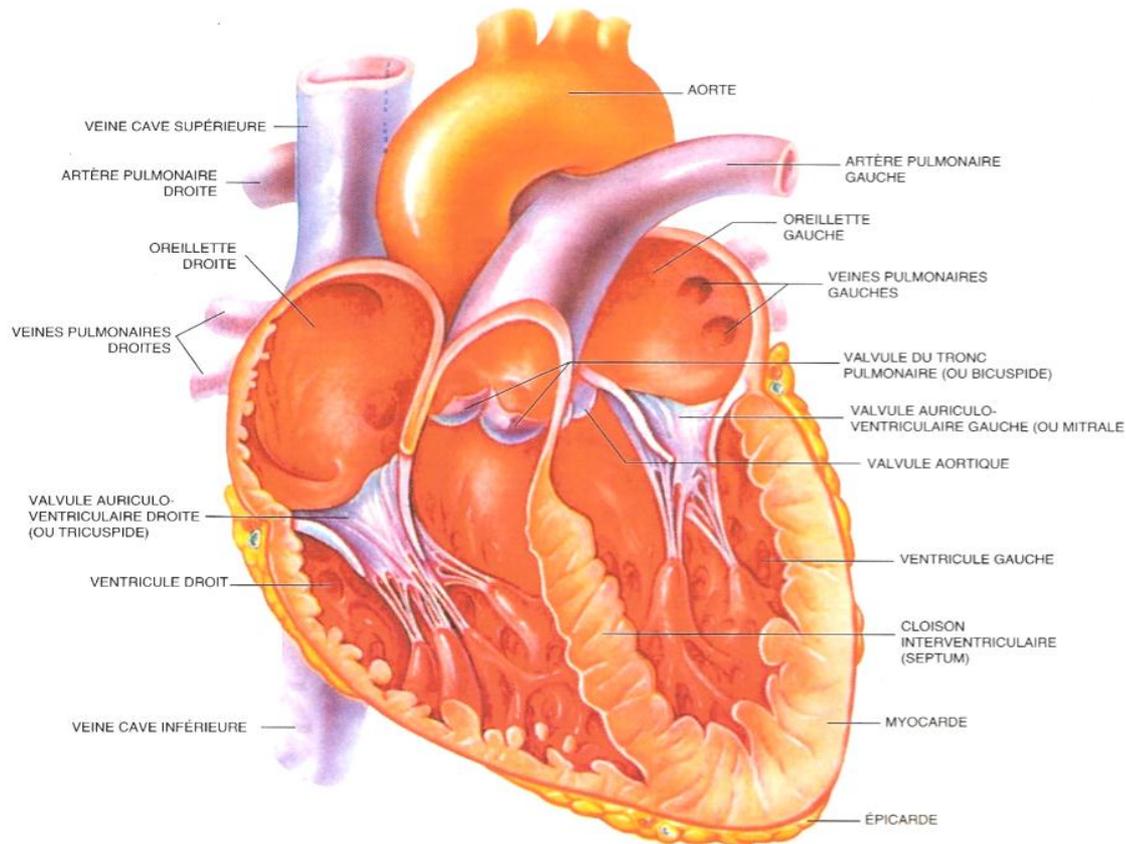
Avoir du cœur suffit-il pour être performant ?

Laurent Bosquet



Introduction

Le cœur



Avoir le cœur gros

Le cœur a ses raisons ...

Fendre le cœur

Ne pas avoir de cœur

Être un joli cœur

Avoir le cœur sur la main

Introduction

Le cœur



Le Soldat de Marathon

Luc Olivier Merson (1869)



Clarence DeMar

(1889-1958)

Introduction

Le cœur



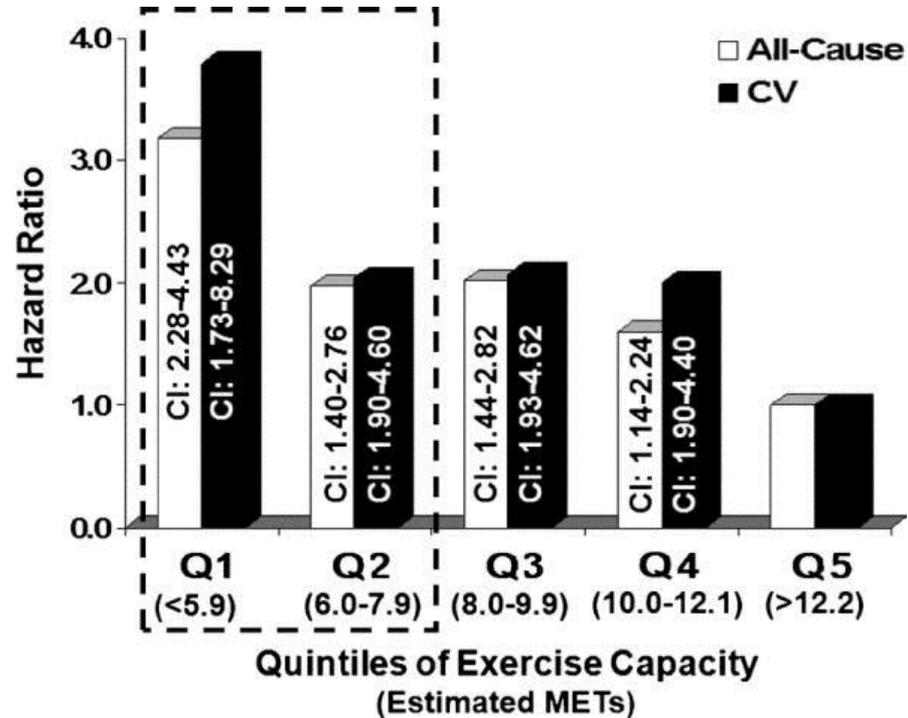
The NEW ENGLAND
JOURNAL of MEDICINE

Half a Century of Running — Clinical, Physiologic and Autopsy Findings in the Case of Clarence DeMar (Mr. Marathon)

James H. Currens, M.D.[†], and Paul D. White, M.D.[‡]
N Engl J Med 1961; 265:988-993 |

Introduction

Aptitude cardio-respiratoire et santé



4384 participants évalués en moyenne tous les 8 ans pendant une période de 20 ans

Introduction

Aptitude cardio-respiratoire et santé

L'activité physique est un traitement efficace pour lutter contre :

- Dyslipidémies
- Hypertension artérielle
- Certains cancers
- Diabète de type 2

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Abstract
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Abstract—Previous training on b meta-analysis tant cardiovas endurance tra intervention d journal up to weighting for reductions of 3.375.5 mm H groups (–6.9) (P<0.05), pla decreased by the homeostatic 0.02 mmol/L vascular resist and favorably

America Sports M Roundta Guidelin Survivor

EXPERT PANEL

Kathryn H. Schmitz, Kerry S. Courneya, Charles Matthews, Wendy Demark-Wa Daniel A. Galvão, P Bernardine M. Pinto Melinda L. Irwin, P Kathleen Y. Wolin, J Roanne J. Segal, M Alejandro Lucia, M Carole M. Schneider Vivian E. von Gruen Anna L. Schwartz, P

Regular physical activity is associated with a lower risk of cardiovascular disease. This meta-analysis of 19 studies found that regular physical activity reduces the risk of cardiovascular disease by 35%. The benefits of physical activity are seen in both men and women, and in people with and without cardiovascular disease. The benefits of physical activity are seen in people with and without cardiovascular disease. The benefits of physical activity are seen in people with and without cardiovascular disease.

Received May 11, From the Hypertension Belgium. Correspondence robert.iglesias@univ.be (R. Iglesias). © 2005 American Hypertension is a

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Diabetologia (2003) 46: 1071–1081
DOI 10.1007/s00125-003-1160-2

Diabetologia

Meta-analysis of the effect of structured exercise training on cardiorespiratory fitness in Type 2 diabetes mellitus

N. G. Boule¹, G. P. Kenny², E. Haddad³, G. A. Wells⁴, R. J. Sigal^{1,3}

¹School of Human Kinetics, University of Ottawa, Ottawa, Ontario, Canada
²Faculty of Medicine, University of Ottawa, Ottawa, Ontario, Canada
³Department of Medicine, University of Ottawa, Ottawa, Ontario, Canada
⁴Department of Epidemiology and Community Medicine, University of Ottawa, Ottawa, Ontario, Canada

Abstract

Aims/hypothesis. Low cardiorespiratory fitness is a powerful and independent predictor of mortality in people with diabetes. Several studies have examined the effects of exercise on cardiorespiratory fitness in Type 2 diabetic individuals. However, these studies had relatively small sample sizes and highly variable results. Therefore the aim of this study was to systematically review and quantify the effects of exercise on cardiorespiratory fitness in Type 2 diabetic individuals. **Methods.** MEDLINE, EMBASE, and four other databases were searched up to March 2002 for randomized, controlled trials evaluating effects of structured aerobic exercise interventions of 8 weeks or more on cardiorespiratory fitness in adults with Type 2 diabetes. Cardiorespiratory fitness was defined as maximal oxygen uptake ($\dot{V}O_{2max}$) during a maximal exercise test. **Results.** Seven studies, presenting data for nine randomized trials comparing exercise and control groups

(overall n=256), met the inclusion criteria. Mean exercise characteristics were as follows: 3.4 sessions per week, 49 min per session for 20 weeks. Exercise intensity ranged from 50% to 75% of $\dot{V}O_{2max}$. There was an 11.8% increase in $\dot{V}O_{2max}$ in the exercise group and a 1.0% decrease in the control group (post intervention standardized mean difference ±0.33, p<0.003). Studies with higher exercise intensities tended to produce larger improvements in $\dot{V}O_{2max}$. Exercise intensity predicted post-intervention weight of mean difference in HbA_{1c} (r=–0.91, p=0.002) to a larger extent than did exercise volume (r=–0.46, p=0.28). **Conclusions/interpretation.** Regular exercise has a statistically and clinically significant effect on $\dot{V}O_{2max}$ in Type 2 diabetic individuals. Higher intensity exercise could have additional benefits on cardiorespiratory fitness and HbA_{1c}. (Diabetologia (2003) 46: 1071–1081)

Keywords Meta-analysis, Type 2 diabetes mellitus, exercise, fitness, oxygen consumption.

The maximal amount of oxygen consumed during exercise ($\dot{V}O_{2max}$) has been used for decades by exercise physiologists to determine the maximum exercise ca-

pacities of athletes. In recent decades, $\dot{V}O_{2max}$ has had a growing importance in clinical settings and has become the gold standard measure of cardiovascular fitness and exercise capacity [1]. There is evidence from large cohort studies that low cardiorespiratory fitness is a powerful and independent predictor of long-term cardiac mortality in people with diabetes [2, 3, 4], even after controlling for traditional risk factors such as age, hypercholesterolemia, smoking, and hypertension and excluding individuals with evidence of coronary ischaemia during testing. Furthermore, in non-diabetic subjects undergoing repeated maximal

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Corresponding author: Dr. R. J. Sigal, Clinical Epidemiology Program, Ottawa Health Research Institute, 1051 Carling Avenue, Room G-408, Ottawa, Ontario, Canada K1Y 4E9
E-mail: sigal@ohri.ca
Abbreviations: $\dot{V}O_{2max}$ maximal oxygen consumption.

Introduction

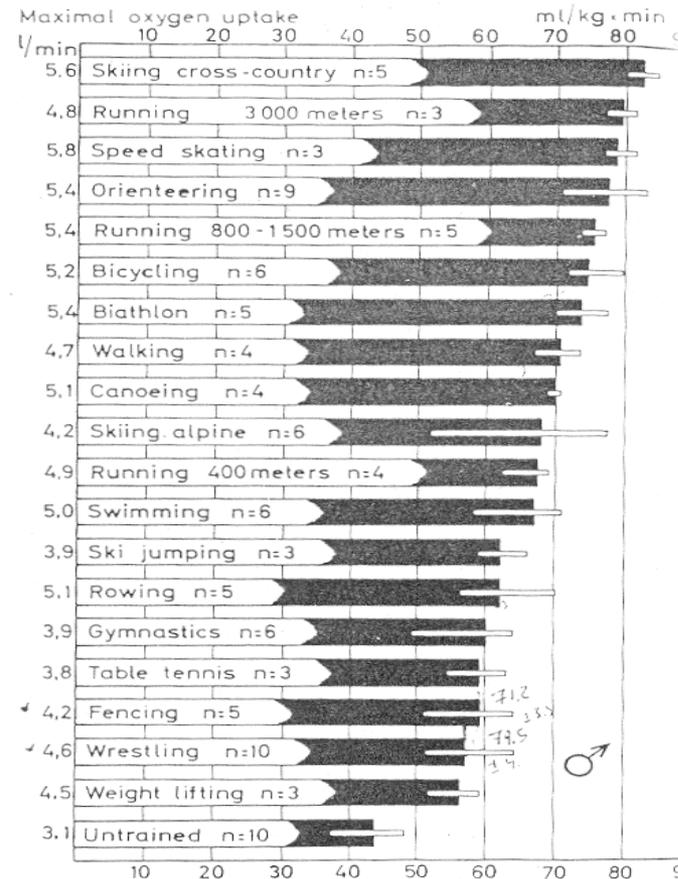
Aptitude cardio-respiratoire et performance



Arthur Vivian HILL

(1886 – 1977)

Prix Nobel de médecine en 1922



La consommation d'oxygène

Le principe de Fick

$$\dot{V}O_2 = \dot{Q}c \times (a - \bar{v})O_2$$

La consommation d'oxygène

Le principe de Fick

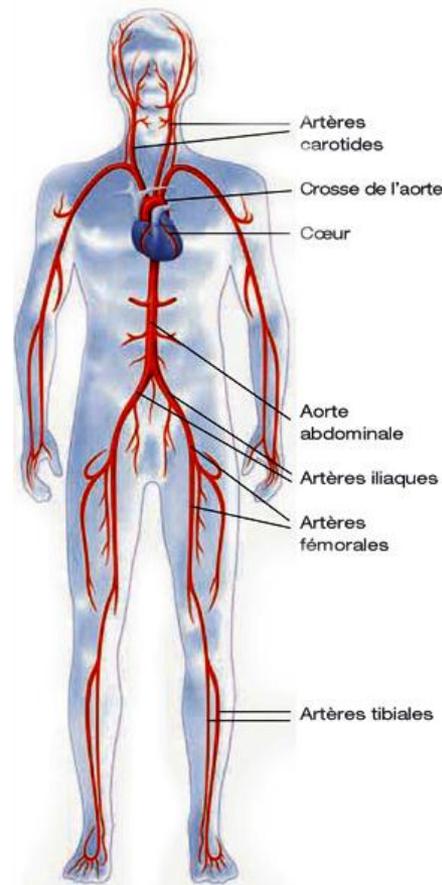
Quelques valeurs



Variable	Sédentaire	Marathonien
VO_2max ($\text{ml}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$)	40	80
Q_c ($\text{l}\cdot\text{min}^{-1}$)	22	35
$(a-v) \text{O}_2$ ($\text{ml}\cdot 100 \text{ ml}^{-1}$)	14	16

La consommation d'oxygène

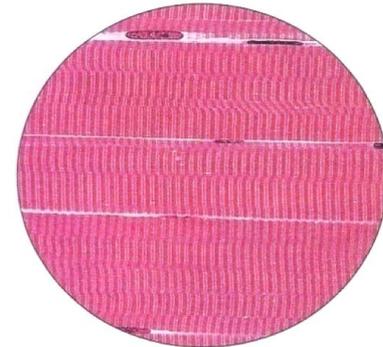
Le système cardiovasculaire



La consommation d'oxygène

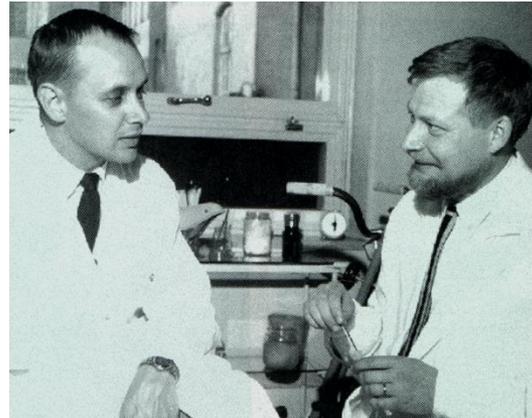
Le principe de Fick

$$\dot{V}O_2 = \dot{Q}c \times (a - \bar{v})O_2$$

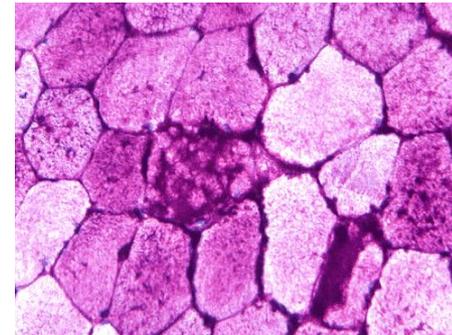
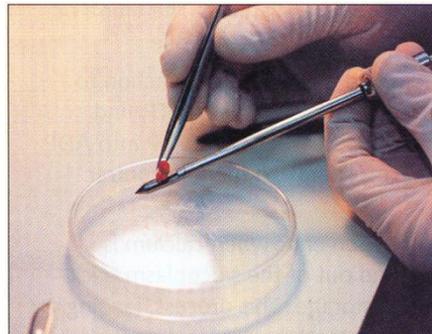
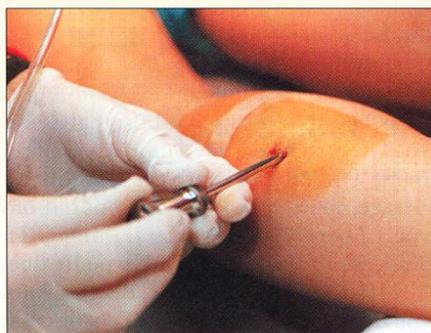


Caractéristiques du muscle

Méthodes d'exploration

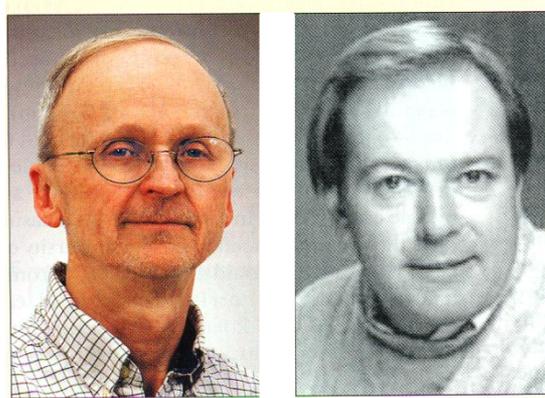


Jonas Bergstrom et Eric Hultman

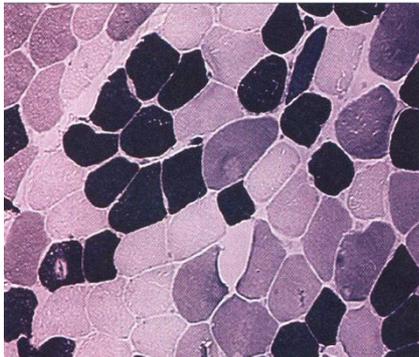


Caractéristiques du muscle

Méthodes d'exploration



Franck Booth et Ken Baldwin



Fibres de type 1 (rouges)

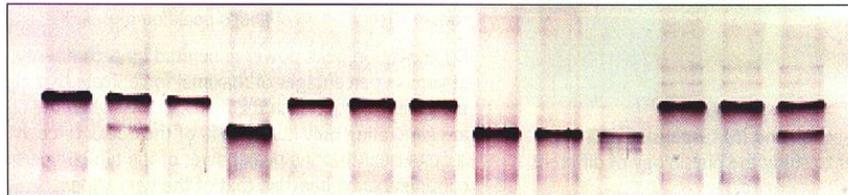
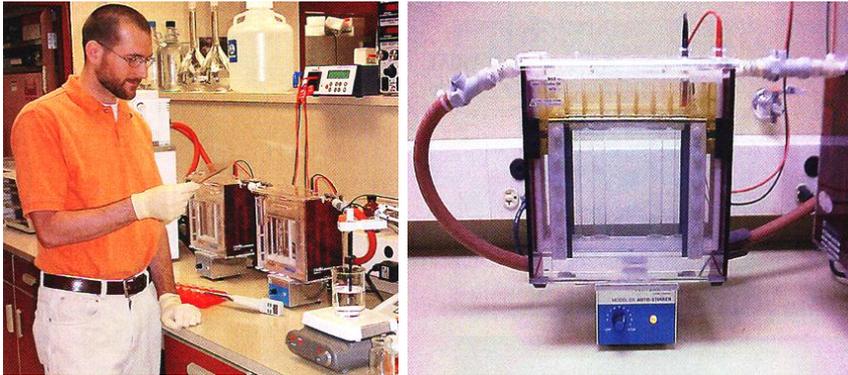
Fibres de type 2a (grises)

Fibres de type 2x (blanches)

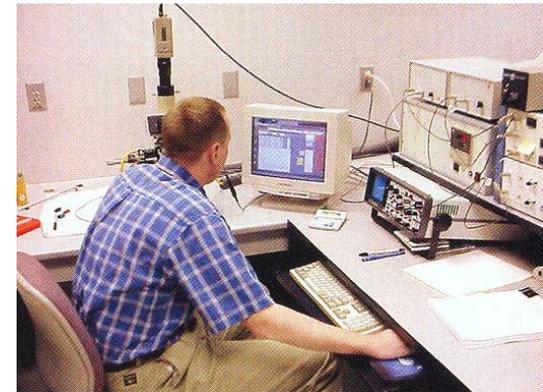
Caractéristiques du muscle

Méthodes d'exploration

L'électrophorèse



La fibre pelée



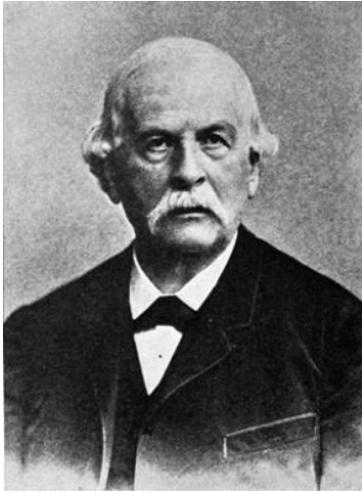
Caractéristiques du muscle

Comparaison fonctionnelle

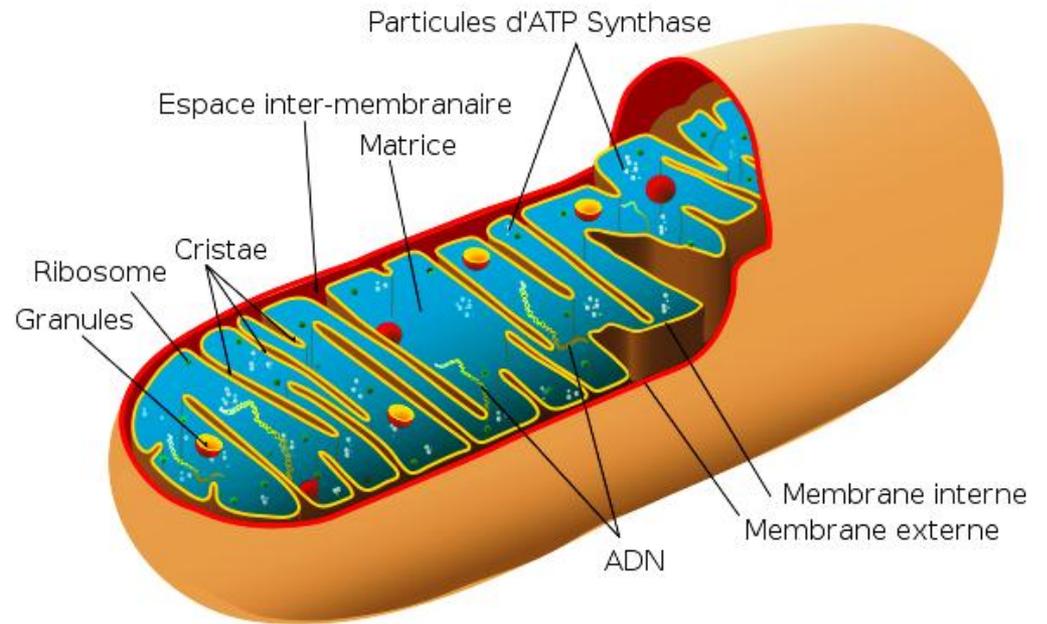
Caractéristique	I	Ila	Iix
Activité de l'ATPase de la myosine	Lente	Rapide	Rapide
Développement du réticulum sarcoplasmique	Faible	Elevé	Elevé
Densité mitochondriale	Elevée	Elevée	Faible
Densité capillaire	Elevée	Elevée	Faible
Concentration de myoglobine	Elevée	Elevée	Faible
Taille des motoneurones	Petite	Grande	Grande
Nombre de fibres par motoneurone	< 300	> 300	> 300
Capacité oxydative	Elevée	Intermédiaire	Faible
Capacité glycolytique	Faible	Elevée	Très élevée

Caractéristiques du muscle

La densité mitochondriale



Rudolph Kölliker
(1857)



Caractéristiques du muscle

Performance sportive

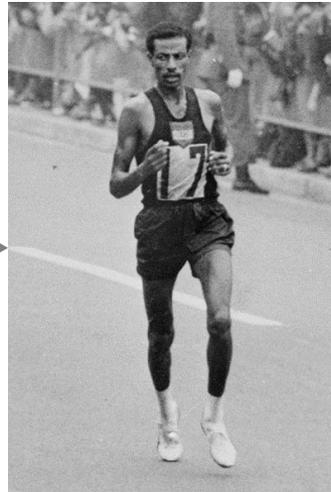
Athlète	Sexe	Muscle	% type I	% type II
Sédentaires	M	Vastes latéraux	47	53
	F	Gastrocnémiens	52	48
½ fond - fond	M	Gastrocnémiens	79	21
	F	Gastrocnémiens	69	31
Sprint	M	Gastrocnémiens	24	76
	F	Gastrocnémiens	27	73

Facteurs de la performance

Coût énergétique

$VO_2\text{max}$
($\text{ml}\cdot\text{min}^{-1}\cdot\text{kg}^{-1}$)

Coût Énergétique
($\text{ml}\cdot\text{kg}^{-1}\cdot\text{m}^{-1}$)



Abebe Bikila

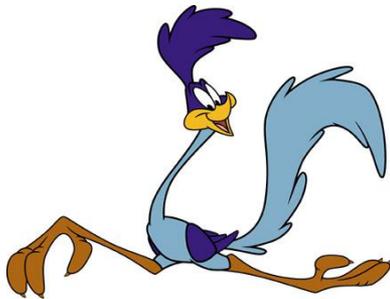
Champion Olympique
du marathon en 1960 et 1964

Coût énergétique

Définition



Litres d'essence pour parcourir 100 km

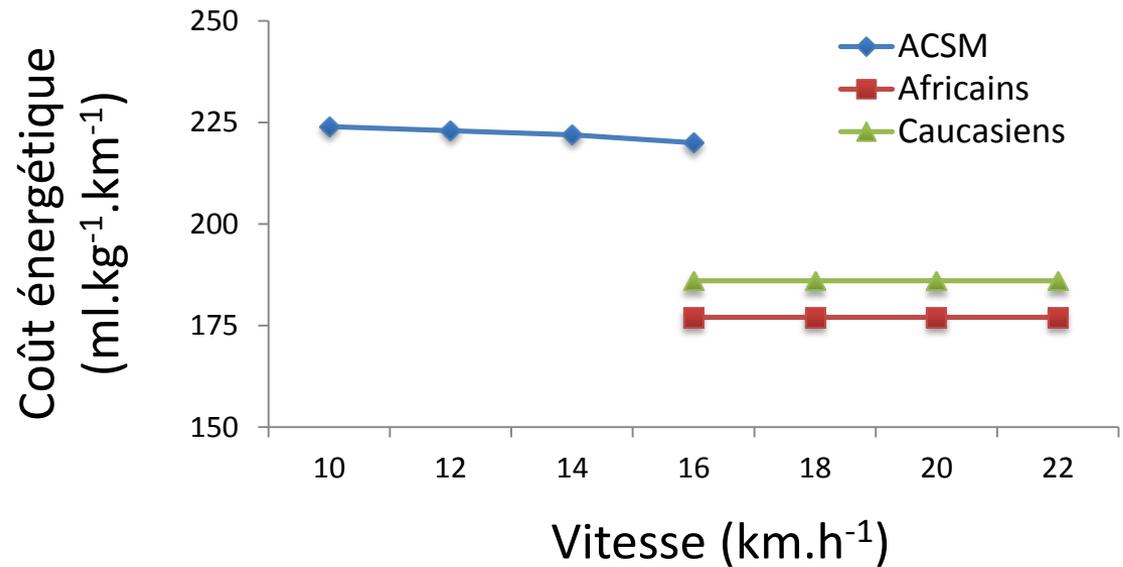


Millilitres d'O₂ pour parcourir 1 km

Coût énergétique

Définition

Quelques valeurs



Coût énergétique

Facteurs sous-jacents

Composition corporelle

Morphologie

Croissance

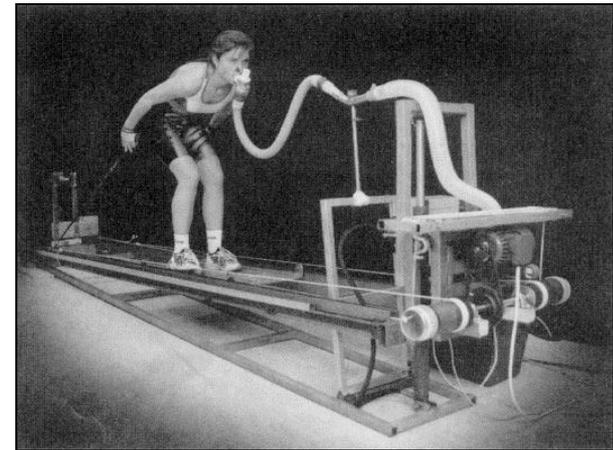
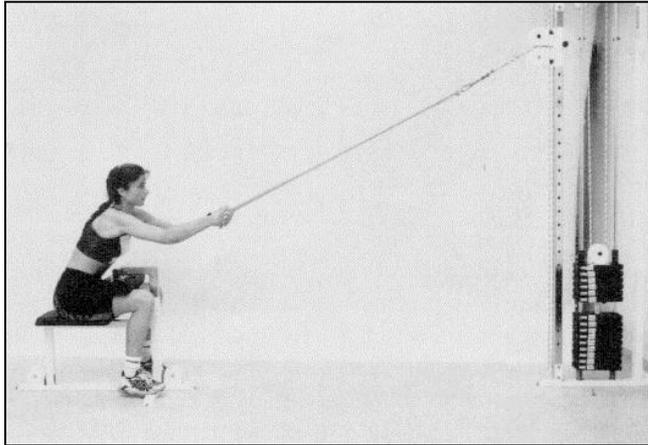
Coût Énergétique
(ml.kg⁻¹.m⁻¹)

Force musculaire

Composante élastique

Coût énergétique

Force maximale



Coût énergétique

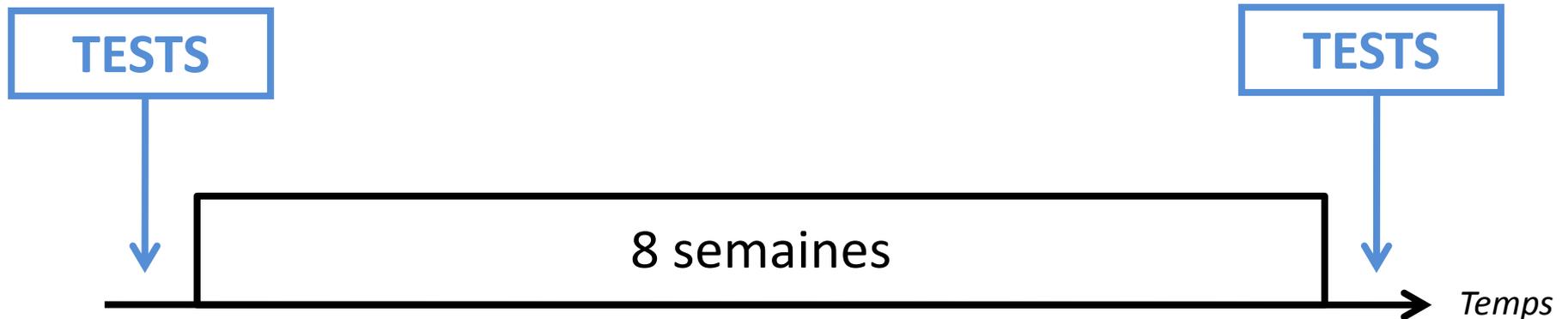
Force maximale

Contenus du programme d'entraînement

	Expérimental	Contrôle
Entraînement aérobie	X	X
Entraînement force max	X	

Coût énergétique

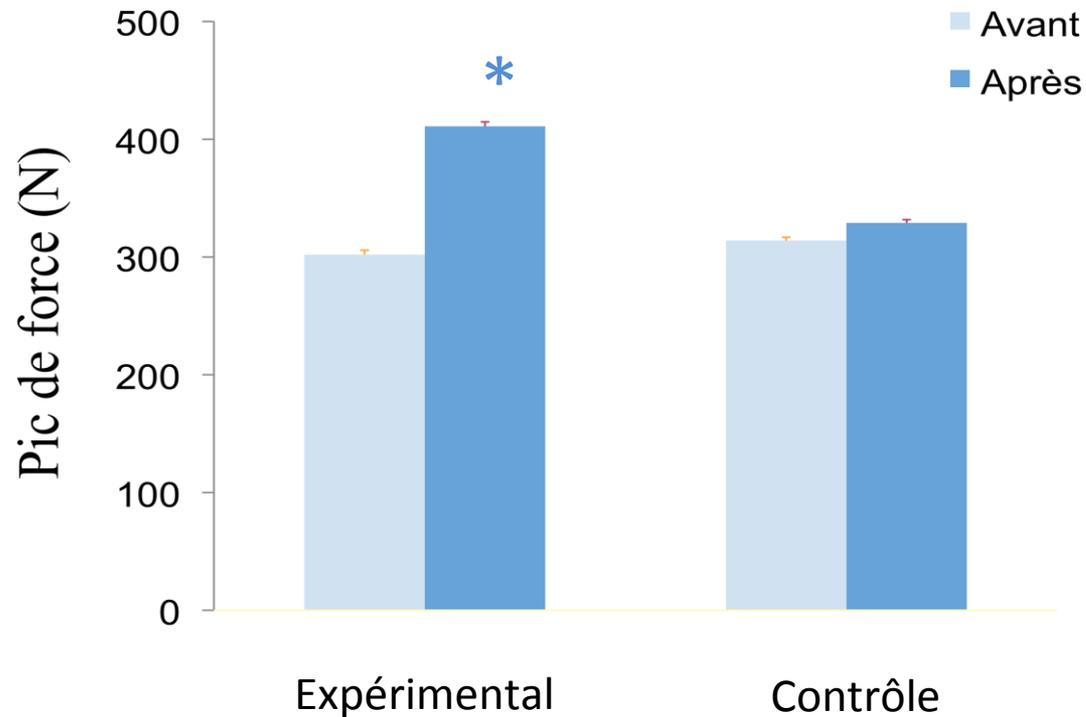
Force maximale



- **Test incrémenté** : coût énergétique, VO_2 max et PAM
- **Test force maximale** : 1 répétition maximale
- **Test à charge constante** : performance

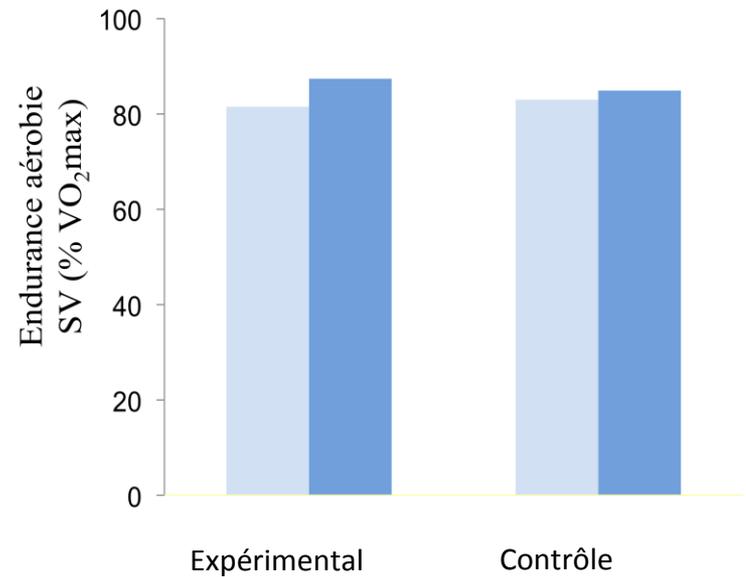
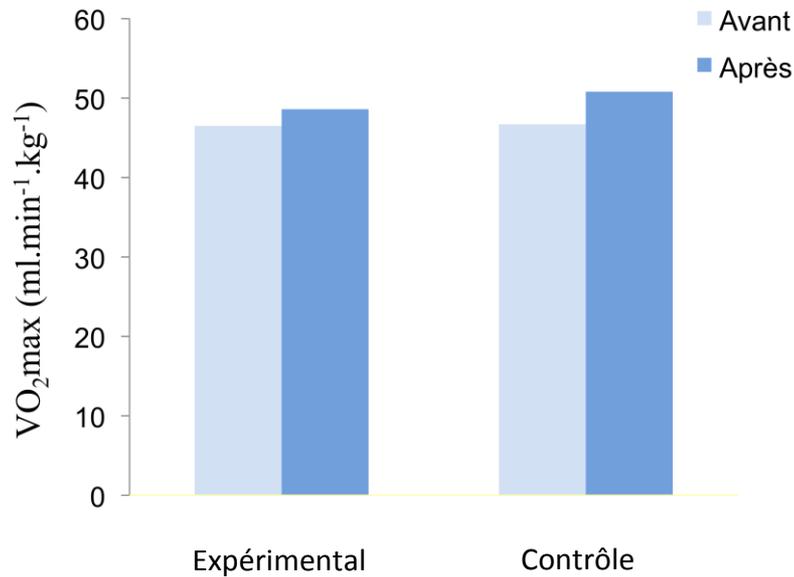
Coût énergétique

Force maximale



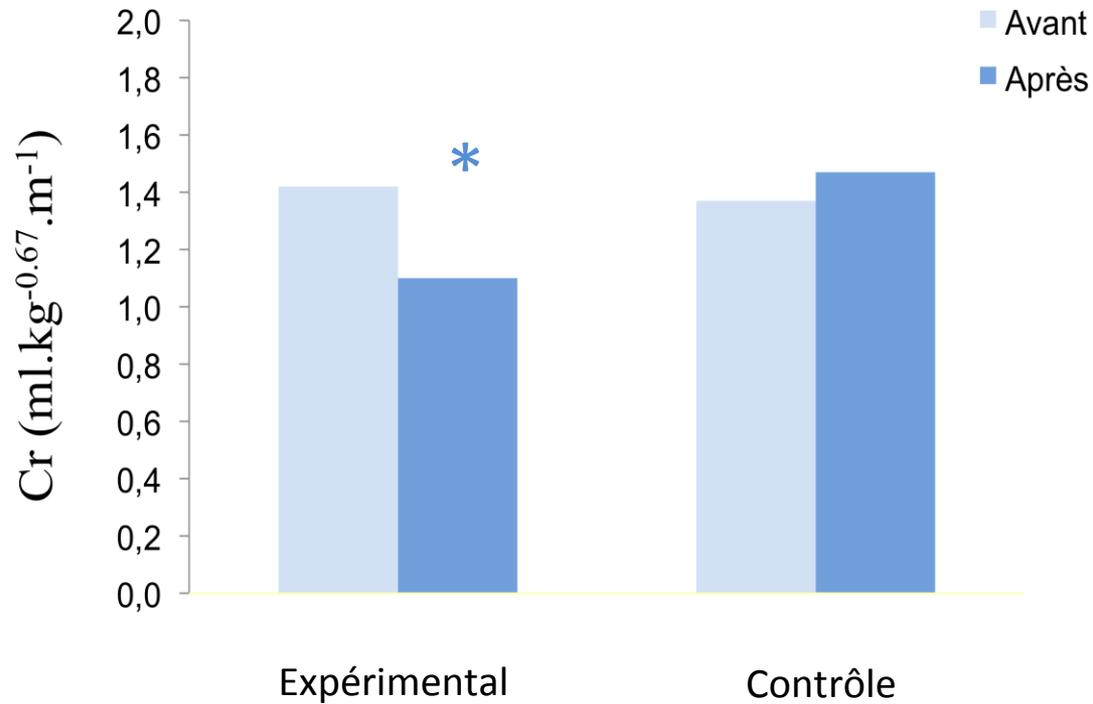
Coût énergétique

Force maximale



Coût énergétique

Force maximale



Coût énergétique

Facteurs sous-jacents

Composition corporelle

Morphologie

Croissance

Coût Énergétique
(ml.kg⁻¹.m⁻¹)

Force musculaire

Composante élastique

La contraction musculaire

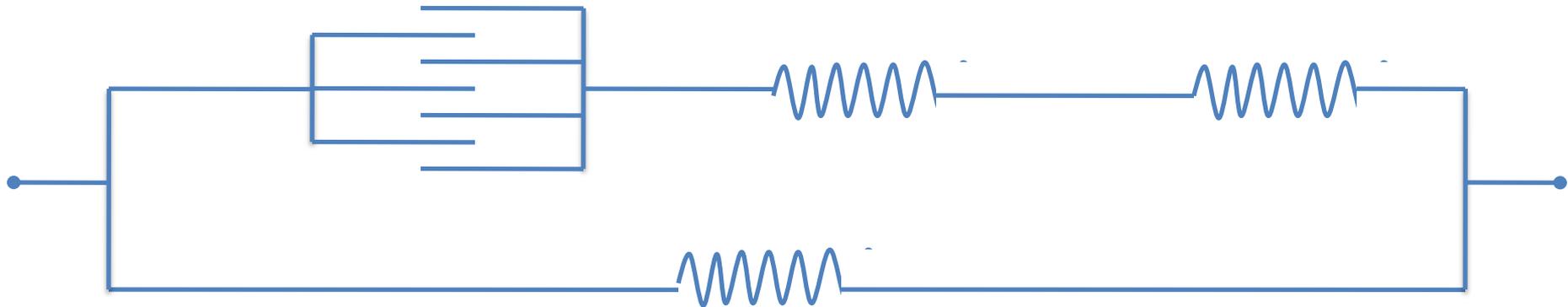
Modèle de Huxley-Simmons

Composante contractile
(filaments actine et myosine)

Composante élastique série

Active
(ponts actine-myosine)

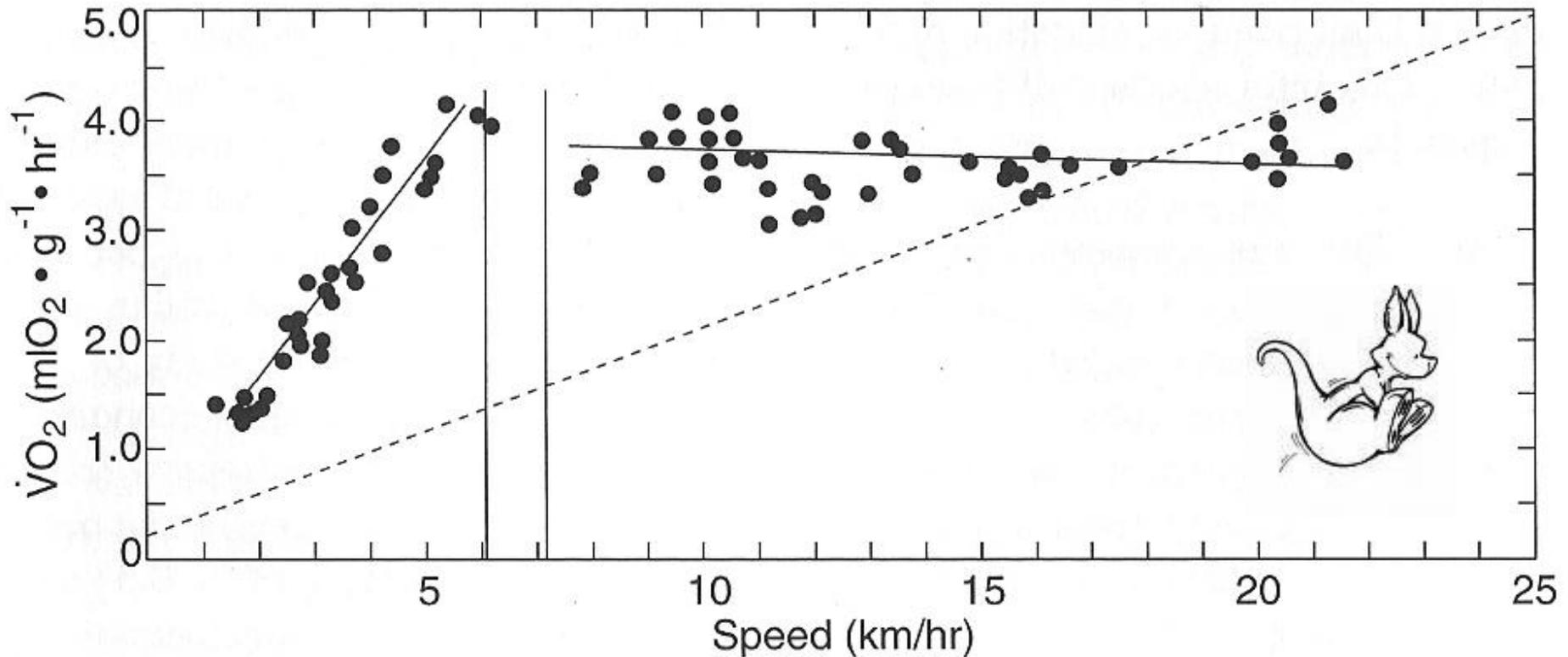
Passive
(tendons)



Composante élastique parallèle
(tissu conjonctif)

Coût énergétique

Composante élastique



Coût énergétique

Composante élastique

EFFECT OF PLYOMETRIC VS. DYNAMIC WEIGHT TRAINING ON THE ENERGY COST OF RUNNING

NICOLAS BERRYMAN,¹ DELPHINE MAUREL,² AND LAURENT BOSQUET^{1,2}

¹Department of Kinesiology, Exercise Physiology Laboratory, University of Montreal, Montreal, Canada; and
²Faculty of Sport Sciences, University of Poitiers, Poitiers, France

ABSTRACT

Berryman, N, Maurel, D, and Boquet, L. Effect of plyometric vs. dynamic weight training on the energy cost of running. *J Strength Cond Res* 24(7): 1818–1825, 2010—The purpose of this study is to compare the effects of 2 strength training methods on the energy cost of running (C_r). Thirty-five moderately to well-trained male endurance runners were randomly assigned to either a control group (C) or 2 intervention groups. All groups performed the same endurance-training program during an 8-week period. Intervention groups added a weekly strength training session designed to improve neuromuscular qualities. Sessions were matched for volume and intensity using either plyometric training (PT) or purely concentric contractions with added weight (dynamic weight training [DWT]). We found an interaction between time and group ($p < 0.05$) and an effect of time ($p < 0.01$) for C_r . Plyometric training induced a larger decrease of C_r (218 ± 16 to 203 ± 13 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{km}^{-1}$) than DWT (207 ± 15 to 199 ± 12 $\text{ml}\cdot\text{kg}^{-1}\cdot\text{km}^{-1}$), whereas it remained unchanged in C. Pre-post changes in C_r were correlated with initial C_r ($r = -0.57, p < 0.05$). Peak vertical jump height ($V_{\text{JH}_{\text{max}}}$) increased significantly ($p < 0.01$) for both experimental groups (DWT = 33.4 ± 6.2 to 34.9 ± 6.1 cm, PT = 33.3 ± 4.0 to 35.3 ± 3.6 cm) but not for C. All groups showed improvements ($p < 0.05$) in Perf_{3000} (C = 711 ± 107 to 690 ± 109 seconds, DWT = 755 ± 87 to 724 ± 77 seconds, PT = 748 ± 81 to 712 ± 76 seconds). Plyometric training were more effective than DWT in improving C_r in moderately to well-trained male endurance runners showing that athletes and coaches should include explosive strength training in their practices with

a particular attention on plyometric exercises. Future research is needed to establish the origin of this adaptation.

KEY WORDS concurrent training, half squat, drop jump, running performance

INTRODUCTION

Successful running performance in long duration events is directly influenced by maximal oxygen uptake ($\dot{V}_{\text{O}_2\text{max}}$), fractional use of $\dot{V}_{\text{O}_2\text{max}}$ (End), and the energy cost of running (C_r) (10). Although we have been aware of its importance since the 1970s, the state of knowledge about C_r is low compared to our understanding of $\dot{V}_{\text{O}_2\text{max}}$ or End (10,13). C_r is the O_2 equivalent of the energy required to run through a given distance at a submaximal speed (32). It is particularly relevant to predict performance in individuals with similar $\dot{V}_{\text{O}_2\text{max}}$ (9) and has been acknowledged as one of the multiple determinants of East African runners' domination in international competitions (21). C_r depends on a complex interplay of factors including training, environment, physiology, biomechanics, anthropometry, and training (32). Recent research suggests that strength training is one of the most powerful interventions for improving C_r (17,28,34,36,37). However, because muscular hypertrophy has been shown to interfere with some peripheral aerobic adaptations, (5,23) it has been suggested that implementations should use strength training methods that emphasize on neural adaptations (11).

Plyometric and dynamic weight training (PT and DWT) fulfill this requirement (14,20,40). Plyometric training involves an eccentric contraction immediately followed by a concentric contraction to allow the muscle to store and recoil elastic energy (6,24,38). Jumps and rebounds are typically used to induce this muscle stretch shortening cycle. Dynamic weight training involves concentric contractions leading to the maximal power output (40). It generally consists in moving relatively light loads (between 30 and 50% of 1 repetition maximum) as fast as possible (40).

The effectiveness of plyometric and DWT (either alone or in combination) to decrease C_r has been highlighted in several convergent reports (28,35,37). In a recent study (35), 8 moderately trained endurance runners improved C_r after

Travail pliométrique



Travail concentrique



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Coût énergétique

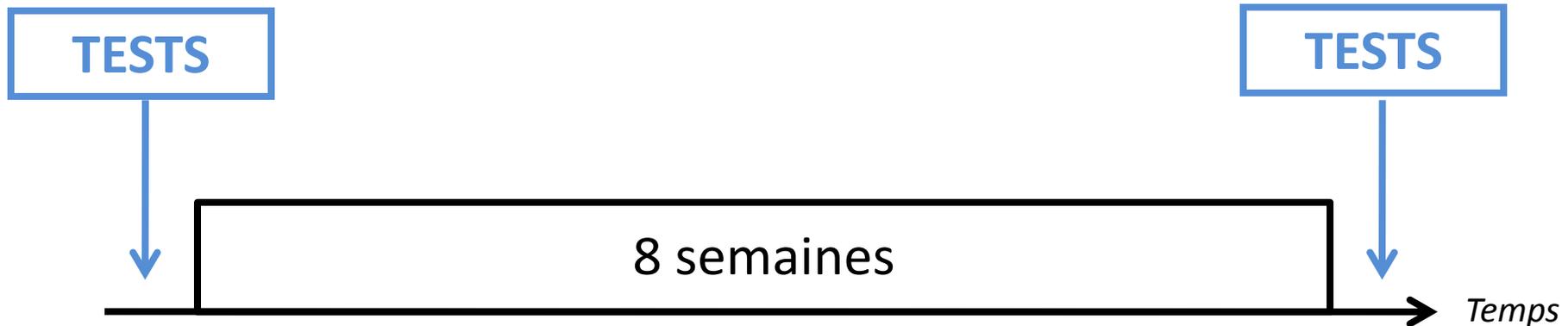
Composante élastique

Contenus du programme d'entraînement

	Pliométrique	Concentrique	Contrôle
Entraînement aérobic	X	X	X
Entraînement puissance	X	X	

Coût énergétique

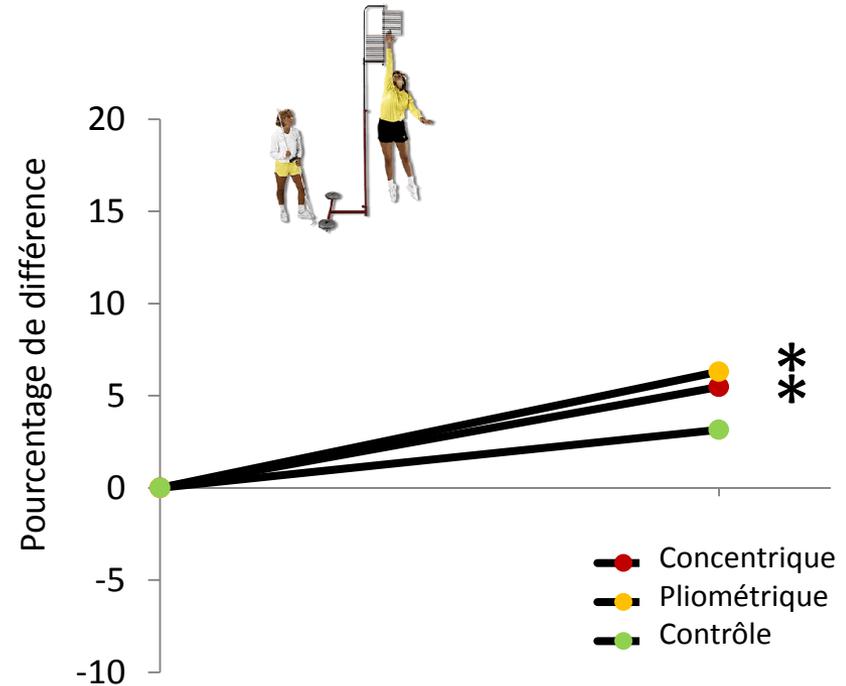
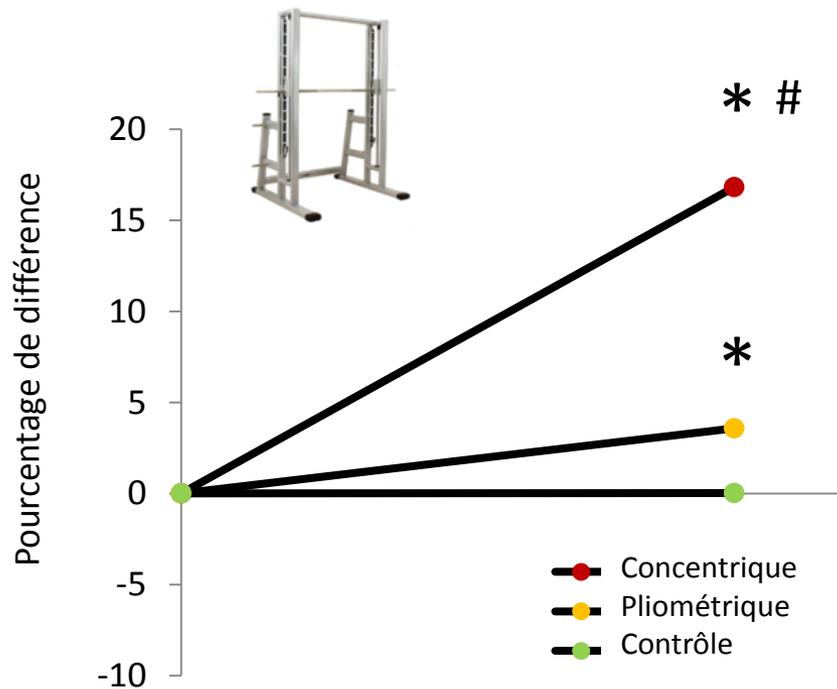
Composante élastique



- **Test incrémenté** : coût énergétique, VO_2 max et VAM
- **Test force-vitesse** : puissance maximale concentrique
- **Test de sauts** : puissance maximale pliométrique
- **Test à travail constant** : performance et endurance

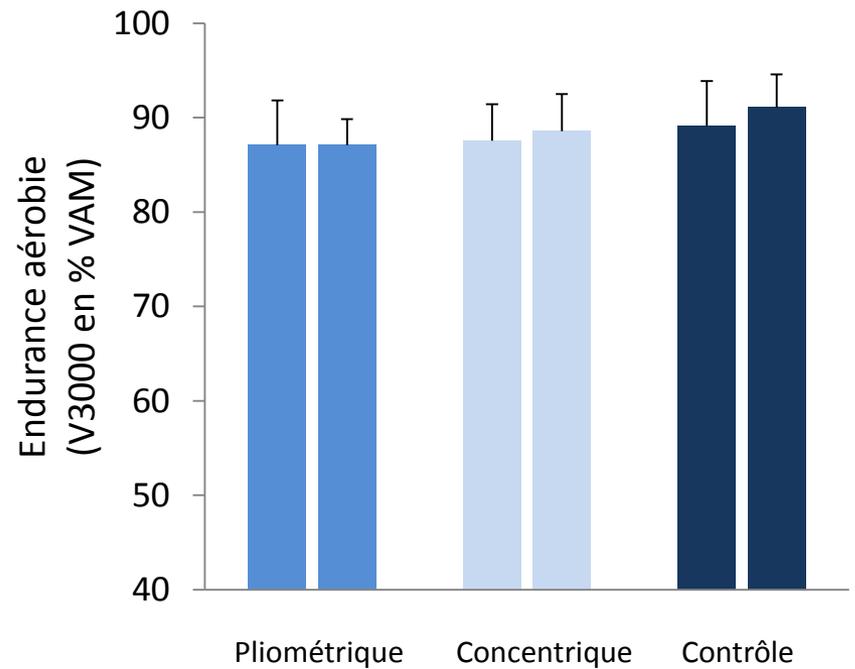
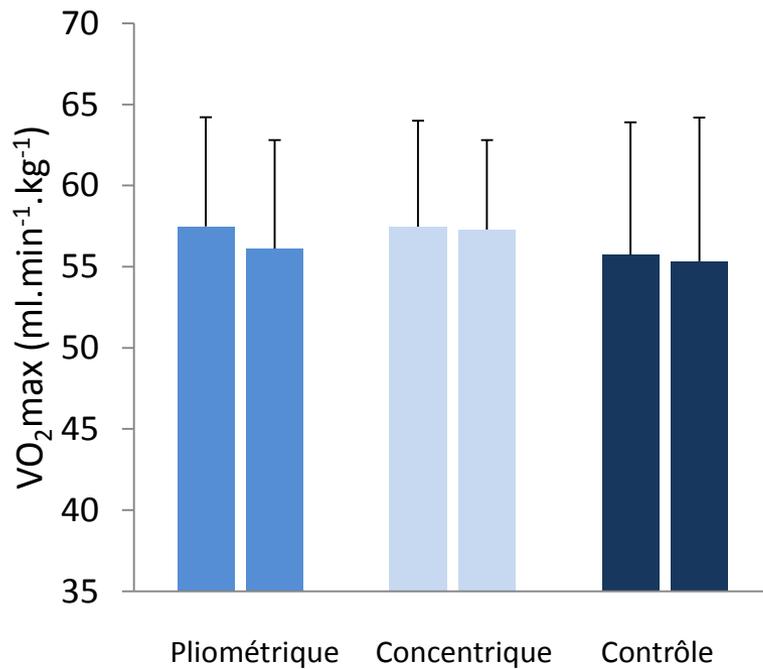
Coût énergétique

Composante élastique



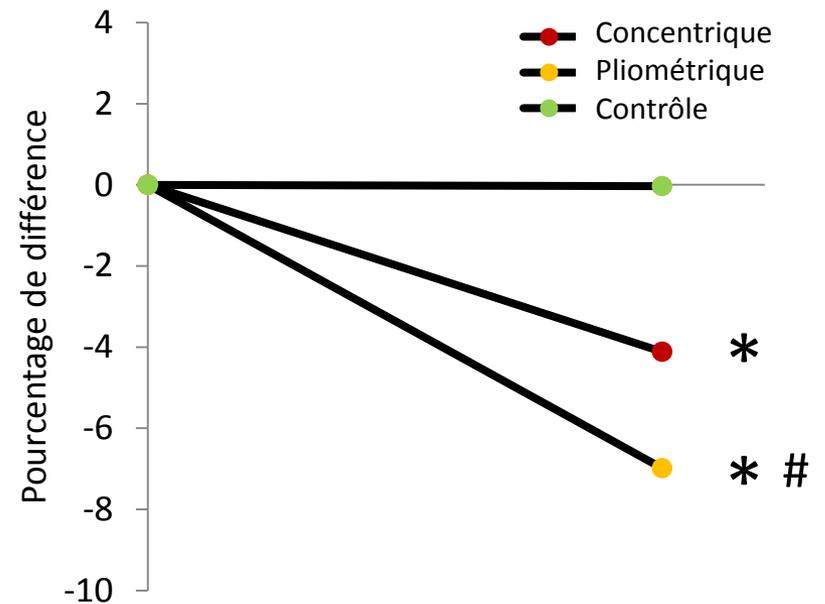
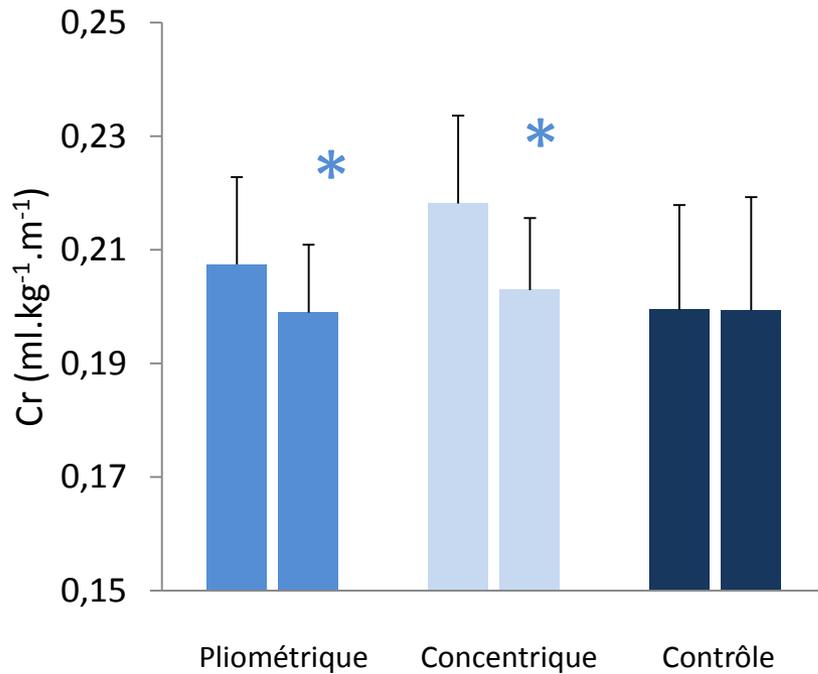
Coût énergétique

Composante élastique



Coût énergétique

Composante élastique



Coût énergétique

Facteurs sous-jacents

Composition corporelle

Morphologie

Croissance

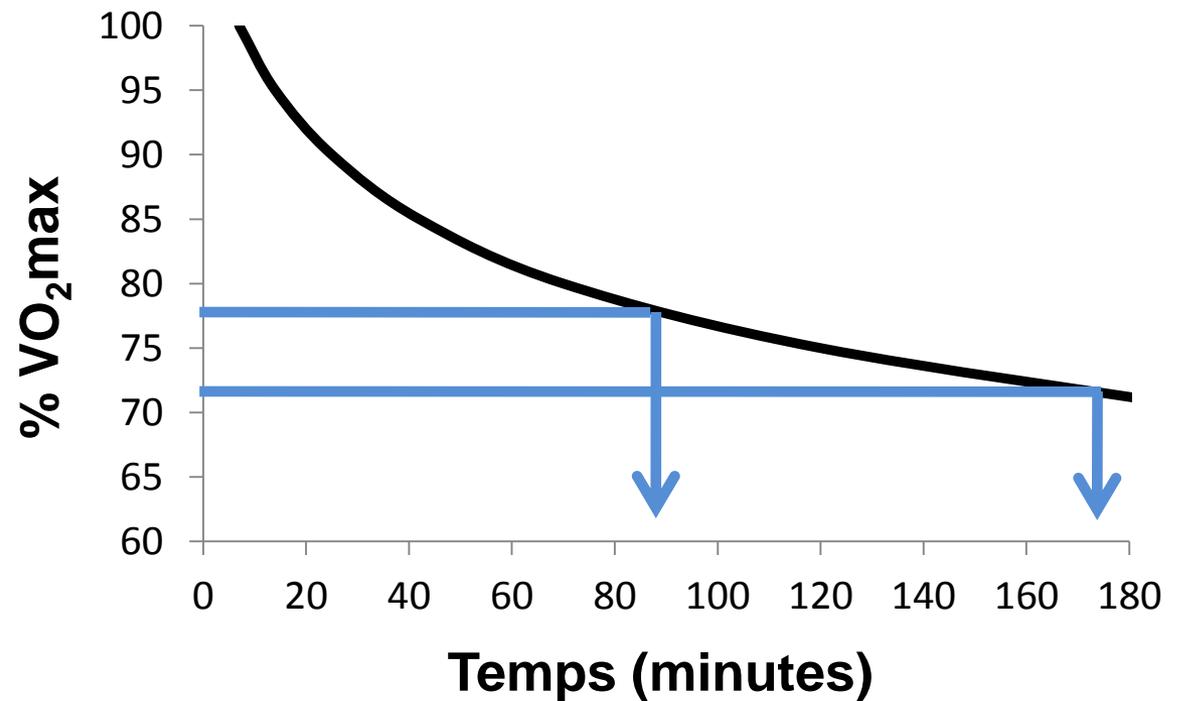
Coût Énergétique
($\text{ml.kg}^{-1}.\text{m}^{-1}$)

Force musculaire

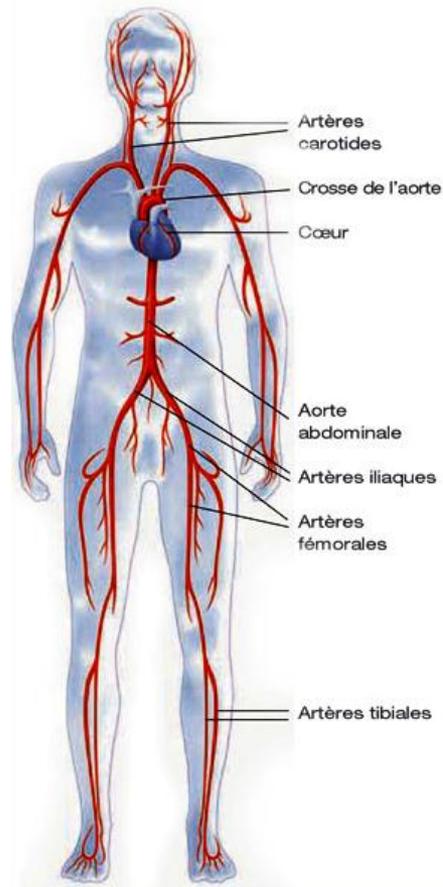
Composante élastique

Coût énergétique

Relation avec la performance



Conclusion



Le **cœur** occupe une fonction centrale dans la performance humaine

Le rôle du **muscle** est souvent sous-estimé. Pourtant ses caractéristiques structurelles et fonctionnelles jouent un rôle clé dans la capacité à se mouvoir

Un élément clé est la coordination de tous les acteurs. Le chef d'orchestre est le **cerveau**.

Avoir du cœur suffit-il pour être performant ?



Merci de votre attention

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