Association between the first ventilatory threshold and the lean mass

Faoro V[1], Scoubeau C[1], Gillet A[2], Carpentier M[1], Carpentier J[3], Taton O[4], Klass M[3,5]

[1]Cardio-Pulmonary Exercise Laboratory, Faculty of Motor Sciences (FSM) [2]Departement of Cardiology, HUB Erasmus Hospital [3]Research Unit in Biometry and Exercise Nutrition, FSM [4] Department of Pneumology, HUB Erasmus Hospital [5]Laboratory of Applied Biology and Research Unit in Applied Neurophysiology, FSM, Brussels, Belgium

INTRODUCTION & METHODS

Cardio-pulmonary exercise testing (CPET) and dual-energy X-ray absorptiometry (DEXA) are extensively used in athletic or clinical follow-up [1,2]. Despite their independent value, the combined use of both tests can provide a more comprehensive understanding of a participant's health, physical condition, and training improvements. Also, the first ventilatory threshold (VT1) is an important outcome in the management of different pathologies as it reflects the exercise intensity associated with the onset of anaerobic metabolism and concomitant exercise-related hyperventilation, or higher perceived exertion [3,4].

We therefore studied the influence of body composition on VT1. We hypothesized that a larger leg muscle mass (LMleg) would be associated with a higher VT1, as measured during a cyclo-ergometric cardiopulmonary exercise test (CPET)

METHODS

Study sample

A total of 316 subjects referred to the laboratory at baseline

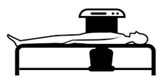
	N	Female %	Age (y)	Height (cm)	Weight (Kg)	BMI (Kg/m²)
Healthy Control	N=60	60%	37 ± 16	171 ± 9	67 ± 11	26.2 ± 6.9
Obesity patients	N=94	49%	45± 15*	172 ± 9	107 ± 18***	36.7 ± 5.4***
Diabetic patients	N=49	38%*	48 ± 14*	173 ± 11	88 ± 18	29.2 ± 4.9*
Cardiac Patients	N=113	12%*	62 ± 10**	173 ± 7	83 ± 14	27.8 ± 4.3

Amongst them, 188 subjects repeated the tests :
- 17 after 6 months post-bariatric surgery
- 171 after 3 months of 3x1h/week concurrent aerobic and resistance training

Protocol

All subjects underwent the following set of test:

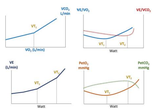
Clinical Examination



Body composition (DEXA scan)

Cardio-pulmonary Exercise Test (CPET)

VT1 was estimated by the V-slope and ventilatory equivalent methods, by two independent investigators[3,5].



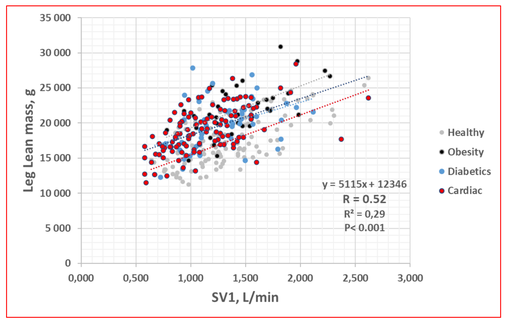
Statistics

Data are expressed as means ± SD.
A normality test was performed to assess Gaussian distribution. In the case of normality, differences between groups were evaluated using repeated measures one-way ANOVA. A **multiple linear regression model** was generated to determine whether an association existed between the dependent variable VT1 and independent variables sex, age, BMI, FM or LM.

RESULTS

Influence of lean mass

The lean mass of the legs was correlated to VT1 (ml/min) independently of sex, age, BMI, pathology and training, suggesting that the muscular mass is a major determinant of the muscular oxidative capacity.



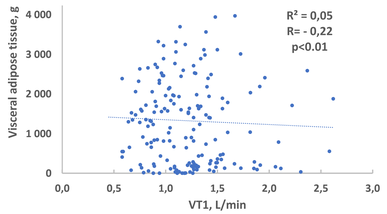
However, other factors interfere, such as:
- Muscle fiber composition (percentage of slow-twitch fibers),
- Myocyte oxidative capacity, including mitochondrial biodisponibility and oxidative enzyme capacity.
- Lactate clearance : or the ability to clear lactate from bloodstream.

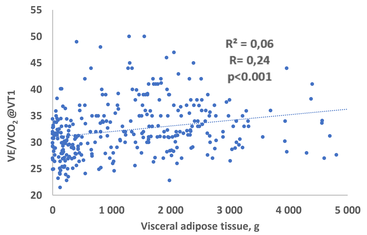
Influence of adipose tissue

VT1 (l/min) was also influenced, to a lesser extend, by the amount of visceral adipose tissue but not total fat mass. This suggests a negative influence of metabolic disturbances rather than an impact of adipose tissue itself.

Also, VT1 expressed relative to body weight (L/min/kg) or VO2peak (% VO2peak) were correlated to total and visceral fat mass (both, r=-0.50, p<.001) therefore disfavouring subjects with altered body composition.

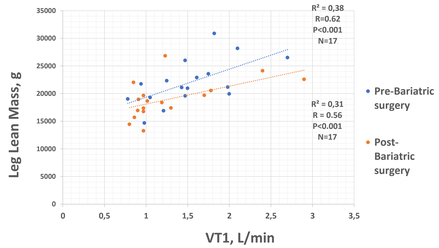
Higher visceral adipose tissue was also associated with lower ventilatory efficiency or higher chemosensibility as reflected by higher Equivalent for CO_2 at VT1 (or VE/VCO_2 slopes, R=0.21, P<0.001).





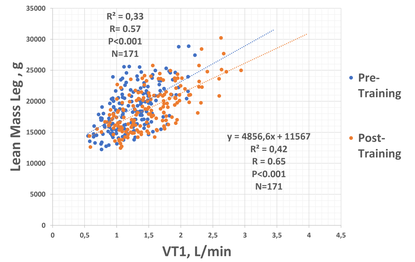
RESULTS & CONCLUSION

Effects of weight-loss



Lean mass or leg lean mass were still correlated to the VT1 (l/min) level after bariatric surgery, when VT1 and LMleg decreased (p=0.01 and p<0.001) and after training when VT increased (p<.001) with little changes in LMleg (p>.05). However, the VT1 changes were not associated to LMleg changes.

Effects exercise training



LMleg and VT1 (l/min) were still correlated after training when VT increased (p<.001) with little changes in LMleg (p>.05).

However, in both cases, the VT1 changes were not associated to the LMleg changes.

CONCLUSIONS

In a large sample composed of sedentary subjects, men and women, with various body compositions and pathologies, a higher leg lean mass is associated to higher VT1 (independent of age, sex, training, pathology, or BMI) allowing to attain a higher exercise intensity before the onset of anaerobic metabolism which exacerbates ventilation.

The metabolic health and the visceral adipose tissue may also interfere with the VT1 level and breathing response to exercise.

Intensive weight-loss or training-induced modifications in VT1 are related to muscle oxidative capacity changes rather than muscle mass changes.

REFERENCES:

1. Martins HA et al. Healthcare 2023
2. Scoubeau C. et al. J Exerc Sci Fit. 2023
3. Anselmi F et al. Scand J Med Sci Sports. 2021
4. Zhou N et al. Obes Facts. 2022
5. Glaab & Taube. Respir Research. 2022

Contact: Pr Vitalie FAORO
Cardio-Pulmonary Exercise Laboratory, Faculty of Motor Sciences
Vitalie.Faoro@ulb.be