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5-7 AVRIL 2018
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3es JOURNÉES FRANCOPHONES DE LA MUCOVISCIDOSE

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L'entraînement sportif des jeunes atteint de mucoviscidose : jusqu'où peut-on aller ?

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Les recommandations

Activité physique régulière

- Pour les enfants de moins de 5 ans, au moins **3 h/j d'AP** sont recommandées soit 15 min/h pour 12h d'éveil.
- Pour les enfants et adolescents âgés de 6 à 17 ans, au moins **60 min/j d'AP** d'intensité modérée à élevée sont recommandées.

Limiter la sédentarité

- limiter la durée quotidienne totale des activités sédentaires en période d'éveil,
- limiter la durée de chaque activité sédentaire, pour **ne pas dépasser 1h en continu pour les moins de 5 ans et 2h pour les 6-17 ans**.

anses
agence nationale de sécurité sanitaire
alimentation, environnement, travail

Inserm
Institut national
de la santé et de la recherche médicale

Organisation mondiale de la Santé

Aerobic training compared with no physical training for cystic fibrosis

Patient or population: adults and children with cystic fibrosis
Settings: Outpatients
Intervention: Aerobic training
Comparison: No physical training

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	No physical training	Aerobic training				
Exercise capacity: change in VO_2 peak during maximal exercise (mL/min per kg body weight) Follow-up: from hospital discharge up to 3 years	Short-term improvements in exercise tolerance during aerobic training were significantly greater than with no physical training at hospital discharge and 1 month after hospital discharge One study showed no difference between groups at 3 months and 1 study showed a significant improvement in exercise tolerance following aerobic training at 6 months compared to no physical training No significant longer-term differences between groups were observed		NA	170 (4 studies)	⊕◯◯◯ **very low**[1,2,3]	
Pulmonary function: change in FEV (% predicted) Follow-up: from hospital discharge up to 3 years	There were no short-term differences between groups at hospital discharge or one month after hospital discharge Two studies showed a significant improvement in pulmonary function during and following aerobic training at 3 months, 6 months and 18 months post-training compared to no physical training However, 1 study showed no significant dif-		NA	187 (5 studies)	⊕⊕◯◯ **low**[1,2]	

Cochrane Database Syst Rev. 2017 Nov 1;11:CD002768. **Physical exercise training for cystic fibrosis.** Radtke T, Nevitt SJ, Hebestreit H, Kriemler S.

	ferences in annual change of pulmonary function between groups were observed over 36 months			
HRQoL CFQ Quality of Well-being Scale and perceived 'positive effects.' Follow-up: one month after hospital discharge up to three years	No significant differences between the groups were shown according to the CFQ A significant improvement in HRQoL according to the Quality of Well-being Scale was observed in the aerobic exercise group compared to the no physical training group at 1 month after hospital discharge, MD 0.10 (95% CI 0.03 to 0.17) Positive effects were reported by 43 out of 49 participants (not reported by treatment group)	NA	143 (3 studies)	⊕⊕◯◯ **low**[1,4]
CF-related mortality Follow-up: NA	Outcome not reported.			NA
Pulmonary exacerbations: number of hospitalisations and number of days in hospital Follow-up: up to three years	There were no between-group differences reported for the mean number of hospitalisations or mean number of days in hospital at year 1, 2 and 3	NA	65 (1 study)	⊕⊕◯◯ **low**[1,5]
Diabetic control Follow-up:NA	Outcome not reported.			NA
Adverse events Follow-up: up to two years	One study reported that no adverse effects occurred. In the other study, 1 participant in the aerobic training group injured her ankle and missed 2 days of aerobic training. One participant from the control group developed haemoptysis and withdrew from the study	NA	71 (2 studies)	⊕⊕⊕◯ **moderate**[1]

Cochrane Database Syst Rev. 2017 Nov 1;11:CD002768. **Physical exercise training for cystic fibrosis.** Radtke T, Nevitt SJ, Hebestreit H, Kriemler S.

Anaerobic training compared with no physical training for cystic fibrosis

Patient or population: adults and children with cystic fibrosis
Settings: outpatients
Intervention: anaerobic training
Comparison: no physical training

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	No physical training	Anaerobic training				
Exercise capacity change in VO_2 peak during maximal exercise (mL/min per kg BW) Follow-up: from hospital discharge up to 3 years	One study showed a significant improvement in exercise capacity following anaerobic training at 6 months compared to no physical training No significant differences between groups were observed at any other time points		NA	86 (3 studies)	⊕⊕◯◯ **low**[1,2]	
Pulmonary function: change in FEV1 (% predicted) Follow-up: from hospital discharge up to 3 years	Two studies showed a significant improvement in pulmonary function during and following anaerobic training at hospital discharge, 1 month after discharge, 3 months, 6 months and 18 months post-training compared to no physical training The second study showed no significant differences in lung function at any time point		NA	86 (3 studies)	⊕⊕◯◯ **low**[1,2]	

Cochrane Database Syst Rev. 2017 Nov 1;11:CD002768. **Physical exercise training for cystic fibrosis.** Radtke T, Nevitt SJ, Hebestreit H, Kriemler S.

HRQoL: Quality of Well-being Scale or HRQoL scale physical function Follow-up: up to 2 years	No significant differences between groups were observed according to the Quality of Well-being Scale or HRQoL scale physical function	NA	64 (2 studies)	⊕⊕◯◯ **low**[1,3]
CF-related mortality Follow-up: NA	Outcome not reported.			NA
Pulmonary exacerbations Follow-up: NA	Outcome not reported.			NA
Diabetic control Follow-up: NA	Outcome not reported.			NA
Adverse events Follow-up: 2 years	One study reported that no adverse effects occurred.	NA	22 (1 study)	⊕⊕⊕◯ **moderate**[1]

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
CI: confidence interval; **FEV** : forced expiratory volume in 1 second; **HRQoL**: health-related quality of life; **NA:** not applicable; **VO peak**: peak oxygen consumption.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

1. Downgraded once due to risk of bias: methodological details of the studies relating to randomisation and allocation concealment were unclear; one study used an inadequate method of randomisation and allocation concealment which may have introduced bias.
2. Downgraded once due to applicability: the no physical training group of one study deteriorated more than expected, this should be taken into account when interpreting results.
3. Downgraded once due to applicability: unclear if the measures and questionnaires used were validated in this population.

Cochrane Database Syst Rev. 2017 Nov 1;11:CD002768.
Physical exercise training for cystic fibrosis. Radtke T, Nevitt SJ, Hebestreit H, Kriemler S.

Combined aerobic and anaerobic training compared with no physical training for cystic fibrosis

Patient or population: adults and children with cystic fibrosis
Settings: outpatients
Intervention: combined aerobic and anaerobic training
Comparison: no physical training

Outcomes	Illustrative comparative risks* (95% CI)		Relative effect (95% CI)	No of participants (studies)	Quality of the evidence (GRADE)	Comments
	Assumed risk	Corresponding risk				
	No physical training	Combined aerobic and anaerobic training				
Exercise capacity: change in VO_2 peak during maximal exercise (mL/min per kg body weight) Follow-up: 12 weeks to two years	A significantly higher VO_2 peak was found in the combined training compared to the no physical training group after 12 to 18 months in 1 study No significant difference between groups was found at any other time point		NA	52 (2 studies)	⊕⊕◯◯ **low**[1,2]	Two additional studies recruiting 42 participants showed significant group x time interactions for VO_2 peak; however, these results are not included in this review due to concerns over inconsistencies in the data provided to us by the original trial authors
Pulmonary function: change in FEV (% predicted) or mL Follow-up: 12 weeks to two years	No significant differences in pulmonary function were observed between treatment groups at any time point		NA	103 (3 studies)	⊕⊕◯◯ **low**[1,2]	

Cochrane Database Syst Rev. 2017 Nov 1;11:CD002768. **Physical exercise training for cystic fibrosis.** Radtke T, Nevitt SJ, Hebestreit H, Kriemler S.

HRQoL: CFQ, Medical Outcomes Study-36 Item Short-Form Health Survey, SF-36 Follow-up: 12 weeks to 2 years	Two studies showed no significant differences in any HRQoL scale One study showed a significant improvement in subjective health perception in the combined training group after 3 to 6 months and after 12 to 18 months (but not between 6 and 12 months)	NA	93 (3 studies)	⊕◯◯◯ **very low**[1,2,3]	
CF-related mortality Follow-up: NA	Outcome not reported.			NA	
Pulmonary exacerbations Follow-up: NA	Outcome not reported.			NA	
Diabetic control Follow-up: 12 weeks	Significant differences in some of the parameters were observed in the no physical training group compared to the combined training group and vice versa Also no significant differences were observed for some parameters	NA	14 (1 study)	⊕◯◯◯ **very low**[1,2,3]	The study reported a range of metabolic parameters (HbA1c(%), Glucose AUC, Total Insulin AUC, Insulin Sensitivity Index) Plasma Glucose and Plasma Insulin
Adverse events Follow-up: NA	Outcome not reported.			NA	

*The basis for the **assumed risk** (e.g. the median control group risk across studies) is provided in footnotes. The **corresponding risk** (and its 95% confidence interval) is based on the assumed risk in the comparison group and the **relative effect** of the intervention (and its 95% CI).
AUC: area under the curve; **CFQ**: Cystic Fibrosis Questionnaire; **CI**: confidence interval; **FEV$_1$**: forced expiratory volume in 1 second; **HRQoL**: health-related quality of life; **NA**: not applicable; **VO$_2$ peak**: peak oxygen consumption.

GRADE Working Group grades of evidence
High quality: further research is very unlikely to change our confidence in the estimate of effect.
Moderate quality: further research is likely to have an important impact on our confidence in the estimate of effect and may change the estimate.
Low quality: further research is very likely to have an important impact on our confidence in the estimate of effect and is likely to change the estimate.
Very low quality: we are very uncertain about the estimate.

Cochrane Database Syst Rev. 2017 Nov 1;11:CD002768. **Physical exercise training for cystic fibrosis.** Radtke T, Nevitt SJ, Hebestreit H, Kriemler S.

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Evaluation de la condition physique et mucoviscidose

TM6'

- Peu corrélé au VO_2max chez l'enfant

Step test

- Step de 15cm, 30/min et 3 min
- Souvent sous max et non progressif

Test navette

- 20m, départ 4 km/h et ↑ 0.5 km/h/min
  - Validé pour CF
- 10m
  - Validé pour CF adulte

Statement on **Exercise Testing** in **Cystic** Fibrosis. Hebestreit H, Arets HG, Aurora P, Boas S, Cerny F, Hulzebos EH, Karila C, Lands LC, Lowman JD, Swisher A, Urquhart DS; European **Cystic** Fibrosis **Exercise** Working Group. Respiration. 2015;90(4):332-51.

Validation of shuttle tests in children with cystic fibrosis. **Selvadurai HC**, **Cooper PJ**, **Meyers N**, **Blimkie** CJ, Smith L, Mellis CM, Van Asperen PP. Pediatr Pulmonol. 2003 Feb;35(2):133-8.

Validity of a modified shuttle test in adult cystic fibrosis. **Bradley J**, **Howard J**, **Wallace E**, **Elborn S**. Thorax. 1999 May;54(5):437-9.

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Evaluation de la condition physique et mucoviscidose

- Évaluation par l'EFX (max)
  - Extrapolation moins fiable
  - Tapis, ergocycle…
  - VO_2max corrélée :
    - Mortalité
    - QoL
    - Hospitalisation

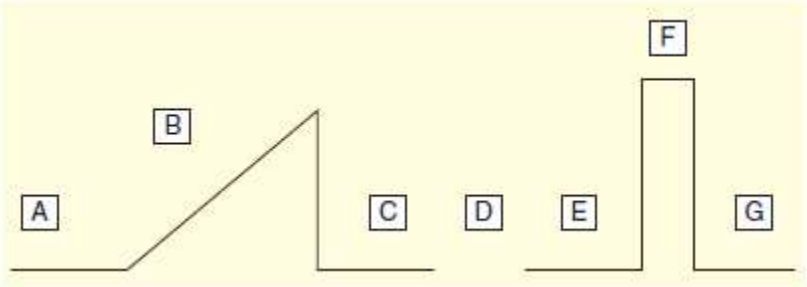

Figure 1. Schematic of the exercise test protocol. A: 3-min warm up at 20 W. B: Incremental ramp exercise at a rate of 10–30 W/min (individualized to patients' anthropometric data). C: 5-min active recovery (unloaded pedaling). D: 10-min seated recovery off the cycle ergometer. E: 3-min warm-up at 20 W. F: Supramaximal confirmation bout of exercise to volitional exhaustion at 110% of the peak power output produced in the prior ramp exercise test B. G: 3-min recovery (unloaded pedaling).

N Engl J Med. 1992 Dec 17;327(25):1785-8. **The prognostic value of exercise testing in patients with cystic fibrosis.** Nixon PA[1], Orenstein DM, Kelsey SF, Doershuk CF.

Pediatr Pulmonol. 2018 Jan;53(1):36-42. **The oxygen uptake efficiency slope is not a valid surrogate of aerobic fitness in cystic fibrosis.** Williams CA[1,2], Tomlinson OW[1,2], Chubbock LV[1], Stevens D[3], Saynor ZL[4], Oades PJ[2], Barker AR[1].

Statement on **Exercise Testing** in **Cystic** Fibrosis. Hebestreit H, Arets HG, Aurora P, Boas S, Cerny F, Hulzebos EH, Karila C, Lands LC, Lowman JD, Swisher A, Urquhart DS; European **Cystic** Fibrosis **Exercise** Working Group. Respiration. 2015;90(4):332-51.

Cystic fibrosis and **physiological responses** to exercise. Williams CA, Saynor ZL, Tomlinson OW, Barker AR. Expert Rev Respir Med. 2014 Dec;8(6):751-62.

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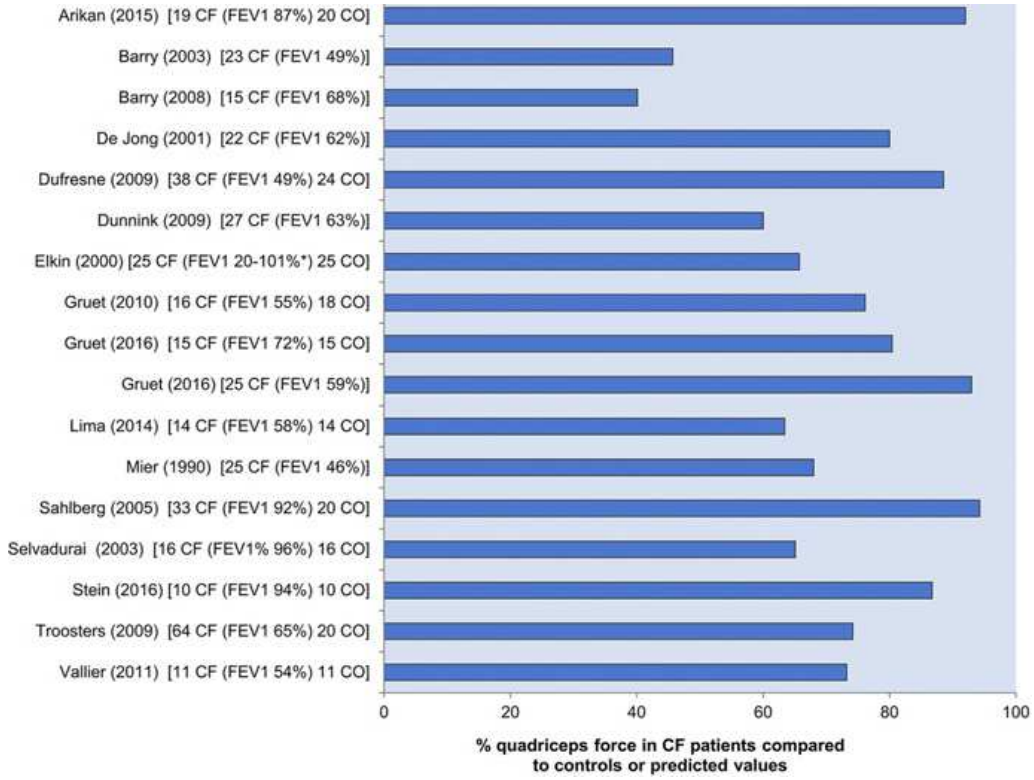
Réponses à l'exercice physique et mucoviscidose

- Facteur limitant l'exercice
  - Métabolisme énergétique musculaire /↓ capacité oxydative
  - ↓ performances anaérobies
    - Sprint, Wingate
  - Mortalité corrélée masse musculaire
  - Recommandations d'exercices de renforcement musculaire



Cystic fibrosis and **physiological responses** to exercise. Williams CA, Saynor ZL, Tomlinson OW, Barker AR. Expert Rev Respir Med. 2014 Dec;8(6):751-62.

J Cyst Fibros. 2017 Sep;16(5):538-552. **Peripheral muscle abnormalities in cystic fibrosis: Etiology, clinical implications and response to therapeutic interventions.** Gruet M[1], Troosters T[2], Verges S[3].

Fogarty AW, Britton J, Clayton A, Smyth AR. Are measures of body habitus associated with mortality in cystic fibrosis? Chest 2012;142:712–7.

Protocoles d'entrainement

Classique

Aérobie

- Marche, vélo, vélo elliptique
- Début à 60% VO_2pic
- Semaines 5-8 : 70%VO_2pic
- Semaines 9-12 : 80%VO_2pic

Renforcement musculaire

- 5-7 exercices des principaux groupes musculaires
- Poids du corps, poids libres ou élastiques
- Objectif : 8-12 répétitions à 30-50% FMV
- Augmentation progressive de l'intensité et de la fréquence

...

Beaudoin N, Bouvet GF, Coriati A, Rabasa-Lhoret R, Berthiaume Y. Combined exercise training improves glycemic control in adults with cystic fibrosis. *Medicine and Science in Sports and Exercise* 2017;**49**(2):231–7.

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Exercices de haute intensité

Protocoles d'entrainement

Baseline patient characteristics.

Variable	
N	33
Sex (M/F)	17/16
Age (y)	19 (9) (9–43)
Height (cm)	159 (14) (131–187)
Weight (kg)	54.2 (15.0) (25.8–77.1)
BMI (kg/m^2)	20.6 (3.5) (14.6–26.6)
Body fat (%)	25.9 (7.8) (12.0–40.8)
FEV_1 (% predicted)	80.8 (18.6) (45.0–111.0)
CRP (mg/L)	3.11 (5.70) (0.10–26.74)
Systolic blood pressure (mm Hg)	107 (11) (89–143)
Diastolic blood pressure (mm Hg)	62 (7) (43–79)
Resting O_2 saturation (%)	97.6 (1.5) (94.0–100.0)
Maximal Exercise Test	
VO_2 peak (L/min)	1.60 (0.59) (0.69–2.90)
VO_2 peak (mL/kg/min)	30.2 (5.9) (17.1–40.6)
VO_2 peak (mL/kgFFM/min)	43.5 (6.8) (30.1–54.1)
VO_2 (% predicted)	75.2 (14.1) (46.0–106.0)
Peak work (W)	132 (42) (65–230)
% VO_2 peak at AT	60.7 (11.6) (22.0–84.0)
VE_{peak} (L/min)	68.9 (25.4) (24.4–130.7)
VE/VCO_2 slope	33.1 (4.5) (23.7–49.2)
Max heart rate (bpm)	170 (20) (100–196)
Resting RER	0.86 (0.06) (0.76–0.99)
Max RER	1.29 (0.14) (1.04–1.60)

BMI = body mass index, FEV_1 = forced expiratory volume in one second, CRP = C-reactive protein, AT = anaerobic threshold, VE_{peak} = peak pulmonary ventilation, RER = respiratory exchange ratio. Data are mean (SD) (range).

Pre- to post-exercise changes in spirometric indices, diffusion capacity, exhaled nitric oxide, and impulse oscillometry (IOS) parameters.

Variable	Pre	Post
FVC (L)	3.44 (3.01–3.86)	3.52 (3.08–3.96)*
FEV_1 (L/min)	2.64 (2.29–2.99)	2.69 (2.33–3.06)*
FEF_{25-75} (L/min)	2.37 (1.92–2.84)	2.48 (1.99–2.98)*
FEV_1/FVC (%)	75.8 (72.6–79.1)	76.0 (72.7–79.3)
FRC (L)	1.69 (1.46–1.92)	1.71 (1.45–1.96)
MVV (L/min)	90.9 (77.7–104.0)	93.1 (79.3–06.8)*
DL_{CO}^{SB} (mL CO min^{-1} Torr^{-1})	22.9 (20.5–25.3)	22.8 (20.5–25.1)
DL_{CO}^{SB} (% predicted)	92.5 (85.4–99.6)	92.1 (85.6–98.6)
FeNO (ppb)	13.6 (9.0–18.2)	12.0 (7.9–16.2)

A single bout of maximal exercise improves lung function in patients with cystic fibrosis. Tucker MA, Crandall R, Seigler N, Rodriguez-Miguelez P, McKie KT, Forseen C, Thomas J, Harris RA. J Cyst Fibros. 2017 Nov;16(6):752-758.

Protocoles d'entrainement

Interval training de haute intensité

- Intérêt pour les patients instables et/ou déconditionnés
  - Pauses

Table 1. Summary of protocols in studies from our laboratory that directly compared 6 weeks of either high-intensity interval training (HIT) or traditional endurance training

Variable	HIT group	Endurance group
Protocol	30 s × 4–6 repeats, 4.5 min rest (3 sessions per week)	40–60 min cycling (5 sessions per week)
Training intensity (workload)	'All out' maximal effort (~500 W)	65% of $\dot{V}_{O_2peak}$ (~150 W)
Weekly training time commitment	~10 min (~1.5 h including rest)	~4.5 h
Weekly training volume	~225 kJ	~2250 kJ

From Burgomaster *et al.* (2008). $\dot{V}_{O_2peak}$, peak oxygen uptake.

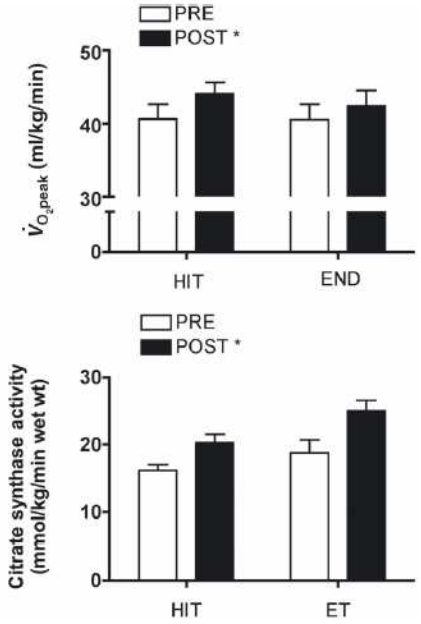


Figure 1. Peak oxygen uptake (top panel) and the maximal activity of the mitochondrial enzyme citrate synthase measured in biopsy samples (bottom panel) obtained before (PRE) and after (POST) 6 weeks of Wingate-based high-intensity interval training (HIT) or traditional moderate-intensity endurance training (ET)
Total exercise volume was 90% lower in the HIT group. Redrawn from Burgomaster *et al.* (2008) with permission. *P ⩽ 0.05 vs Pre; main effect for time.

Burgomaster KA, Howarth KR, Phillips SM, Rakobowchuk M, Macdonald MJ, McGee SL & Gibala MJ (2008). Similar metabolic adaptations during exercise after low volume sprint interval and traditional endurance training in humans. *J Physiol* **586**, 151–160.

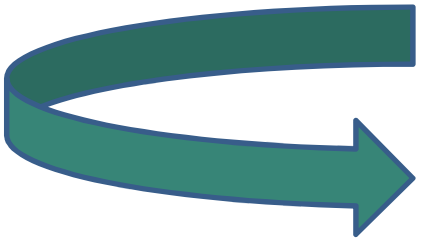
Protocoles d'entrainement

Interval training de haute intensité

TABLE 1 Training intervention

Week	Low intensity (%MSEC)	Duration (sec)	High intensity (%MSEC)	Duration (sec)	Intervals (number)	Supplemental O_2 (L/min)
1	30	60	50	30	10	3
2	30	60	60	30	12	3
3	30	60	70	30	14	3
4	30	60	80	30	16	3
5	30	60	90	30	18	3
6	30	60	90	30	20	3

« PMAn » = 225W



↑ VO_2 max

Physiother Theory Pract. 2011 Apr;27(3):231-7. **High-intensity interval training in an adolescent with cystic fibrosis: a physiological perspective.** Hulzebos HJ, Snieder H, van der Et J, Helders PJ, Takken T.

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Protocoles d'entrainement

Interval training de haute intensité

Interval training

Marche à 3-4km/h
Pendant 16 min
5 fois/semaine
6 semaines

SpO2 < 90% / effort

10 Intervalles de 20 ou 30s à 50% « VMAn »
Suivis de 60s à 0% pente
O_2 pour $SpO_2 \geq 90\%$

Programme standard

Marche, marche nordique, musculation, assouplissements, équilibre
45 min
5 fois/semaine
6 semaines

SpO2 > 90% / effort

Intensité = 60-75% VO_2pic

Innocuité
↑ Performances

J Cyst Fibros. 2014 Jan;13(1):86-91. **Interval exercise training in cystic fibrosis -- effects on exercise capacity in severely affected adults.** Gruber W, Orenstein DM, Braumann KM, Beneke R.

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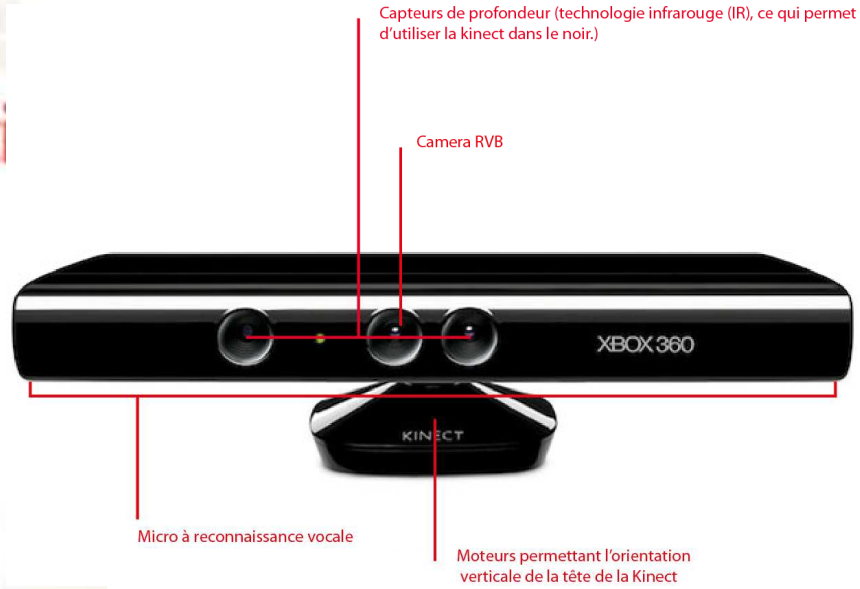
Protocoles d'entrainement

Interval training de haute intensité



J Physiother. 2011;57(1):35-40.**Gaming console exercise and cycle or treadmill exercise provide similar cardiovascular demand in adults with cystic fibrosis: a randomised cross-over trial.** Kuys SS[1], Hall K, Peasey M, Wood M, Cobb R, Bell SC.

J Cyst Fibros. 2013 Dec;12(6):604-8. Epub 2013 Jun 7. **Xbox Kinect™ represents high intensity exercise for adults with cystic fibrosis.** Holmes H[1], Wood J, Jenkins S, Winship P, Lunt D, Bostock S, Hill K.

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Surveillance-Précautions

- Evaluation de la dyspnée et fatigue musculaire à l'effort (Echelle de Borg)
- Contrôle de la FC et de la saturation
- Traitement médical si besoin (bronchodilatateurs)

- Possibilité de pratiquer une activité physique en situation d'exacerbation et/ou avec oxygène

Les précautions

- Chambre à cathéter implantable
  - Éviter les sports de contact
  - Activités aquatiques autorisées
    - Sauf en cas de complications (infection, thrombose)

Les précautions

- GPE
  - La plupart des sports autorisés
  - Éviter les sports avec risque de contacts violents
  - Dans certains cas, possibilité de sac à dos avec pompe portative et poche

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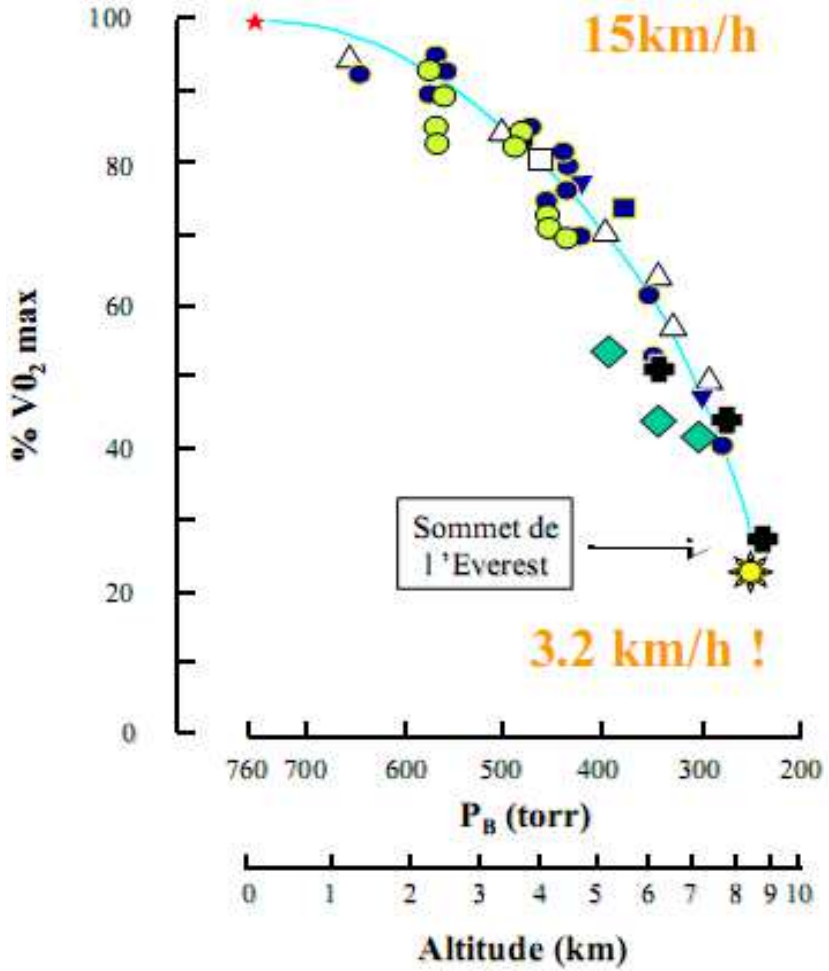
Les troubles sphinctériens

- Incontinence urinaire d'effort
  - ✓ 14.9% des « sportives » de loisir (Salvatore 2008)
    - *Sous estimation probable*
  - ✓ Sport de haut niveau : ≈ 28 à 80%*
  - ✓ Sports à risque
    - À impact élevé : trampoline, gymnastique
  - ✓ 84% des athlètes n'en parlent pas**
    - Ni à leur entraineur, ni aux professionnels de santé
  - ✓ Facteurs déclenchants
    - Rires, saut, CAP, toux, travail abdominaux…
  - ✓ IUE révélée voire aggravée par le sport

*Bo K, Hilde G, Staer-Jensen J, et al. Does general exercise training before and during pregnancy influence the pelvic floor "opening" and delivery outcome? A 3D/4D ultrasound study following nulliparous pregnant women from mid-pregnancy to childbirth. Br J Sports Med 2015;49:196–9.

**Caylet N, Fabbro-Peray P, Mares P, et al. Prevalence and occurrence of stress urinary incontinence in elite women athletes. Can J Urol 2006;13:3174–9.

Les contraintes ambiantes



- Altitude

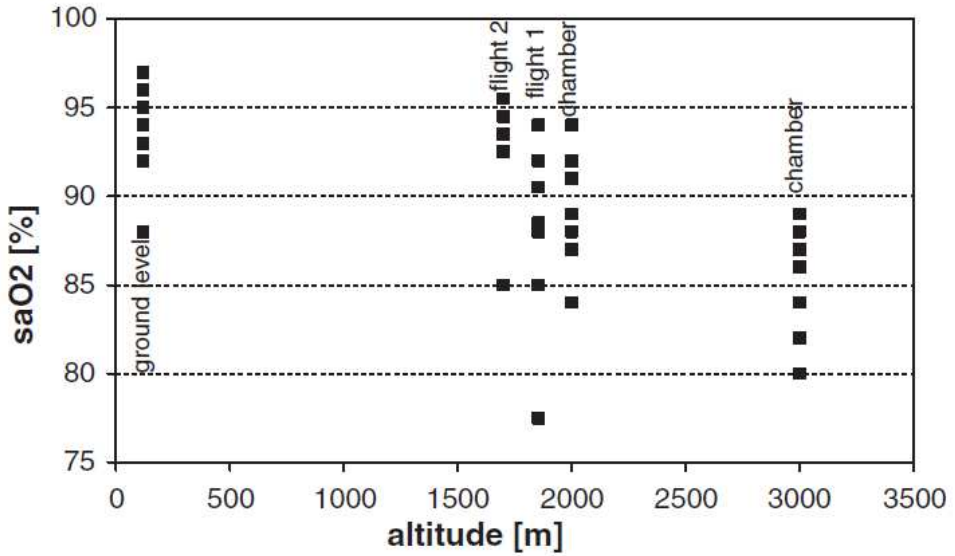


Fig. 2. Altitude dependence of oxygen saturation (saO_2). Given are values of all subjects at ground level (120 m a.s.l.; $n=10$), in the hypobaric chamber (2000 and 3000 m; $n=10$) and during the two flights (1700 and 1855 m; $n=8$ and $n=10$, respectively).

Cerretelli 1988

Predicting hypoxia in **cystic fibrosis patients** during **exposure** to high altitudes. Kamin W, Fleck B, Rose DM, Thews O, Thielen W. J Cyst Fibros. 2006 Dec;5(4):223-8. Epub 2006 May 19.

Les contraintes ambiantes

Altitude et exercice

TABLE 2— Arterial Oxygen Saturation at Peak Exercise and Disease Severity

	Number of patients who desaturate to < 90% and < 85%		Number of patients who desaturate ≥ 5% and ≥ 10% from baseline	
Disease severity group[1]	< 90%[2]	< 85%	≥ 5%[3]	≥ 10%
Total	29 of 50	14 of 50	28 of 50	12 of 50
Normal	0 of 4	0 of 4	0 of 4	0 of 4
Mild	2 of 6	1 of 6	3 of 6	1 of 6
Moderate	15 of 26	6 of 26	14 of 26	3 of 26
Severe	12 of 14	7 of 14	11 of 14	8 of 14

[1]Normal, $FEV_1 > 90\%$ predicted; mild, $\leq 70\%$ $FEV_1 < 90\%$ predicted; moderate, $40\% \leq FEV_1 < 70\%$ predicted; severe, $FEV_1 < 40\%$ predicted.
[2]Includes all subjects who desaturated below 90%.
[3]Includes all subjects who desaturated 5% or more.

Pediatr Pulmonol. 2001 Dec;32(6):437-41. **Oxygen saturation in adult cystic fibrosis patients during exercise at high altitude.** Ryujin DT[1], Mannebach SC, Samuelson WM, Marshall BC.

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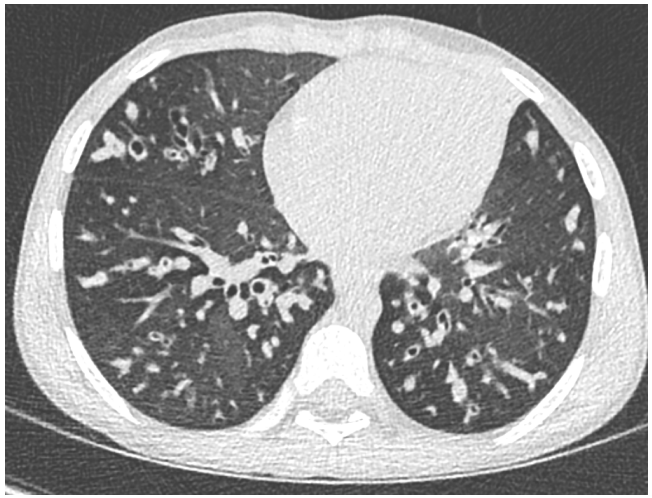
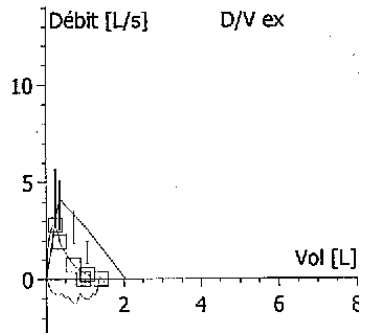
Cas clinique

Jeune fille de 12 ans, atteinte de mucoviscidose dans une forme classique, associant insuffisance pancréatique externe et bronchopathie chronique, avec dilatation des bronches étendue.



EFR

	pré	Théo	LIN	LSN	%Théo
CVF	1.41	2.03	1.61	2.46	69.5
VEMS	0.96	1.75	1.36	2.14	54.8
VEM%VE	67.84	84.97	75.89	94.05	79.8
DEP	2.81	4.22	2.80	5.63	66.5
DEM 75	1.94	3.80	2.54	5.05	51.1
DEM 50	0.72	2.68	1.82	3.54	26.8
DEM 25	0.24	1.37	0.81	1.94	17.5
DEMM	0.53	2.33	1.51	3.15	22.6



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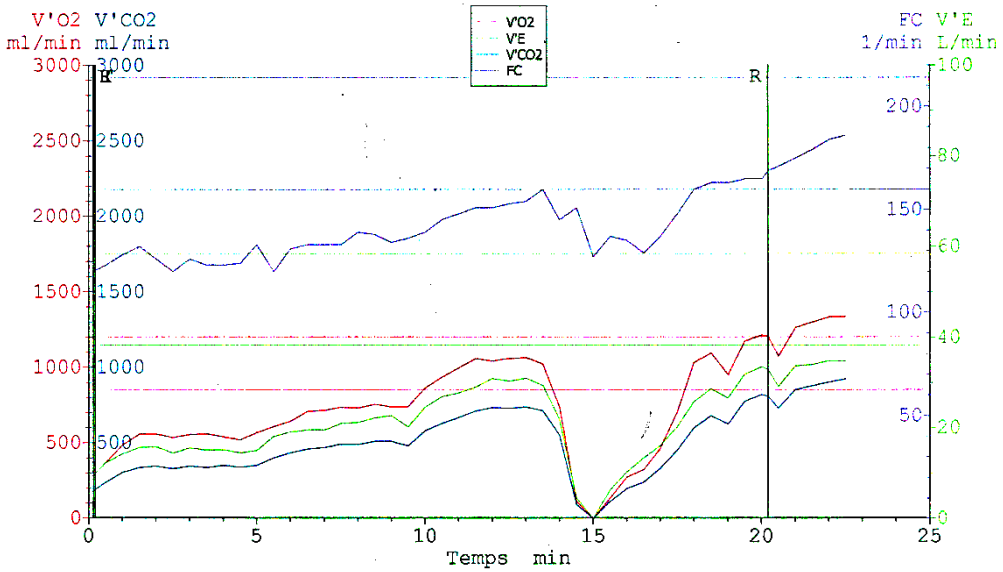
Cas clinique

EFX



Résumé		Repos	AT	Max Watts	Théo	Max 1 %théo	Recup 60 sec
Moyennage temporel 15sSecondes							
Temps	min	00:07		22:00			21:15
t-ph	min	00:07		01:47			01:03
Charge	W	0		0	72	0	0

Résumé		Repos	AT	Max Watts	Théo	Max 1 %théo	Recup 60 sec
Moyennage temporel 15sSecondes							
V'O2	ml/min	283		1386	1029	135	1252
VO2/kg	ml/min/kg	10.9		53.3			48.1
V'CO2	ml/min	183		960			858
VO2%m	%	20		100			90

Résumé		Repos	AT	Max Watts	Théo	Max 1 %théo	Recup 60 sec
Moyennage temporel 15sSecondes							
FC	1/min	120		184	187	98	178
O2/FC	ml	2.4		7.5	6.3	121	7.0
HRR %	%	36		2			5

Résumé		Repos	AT	Max Watts	Théo	Max 1 %théo	Recup 60 sec
Moyennage temporel 15sSecondes							
V'E	L/min	9		37	48	77	34
FR	1/min	25		52	42	126	47

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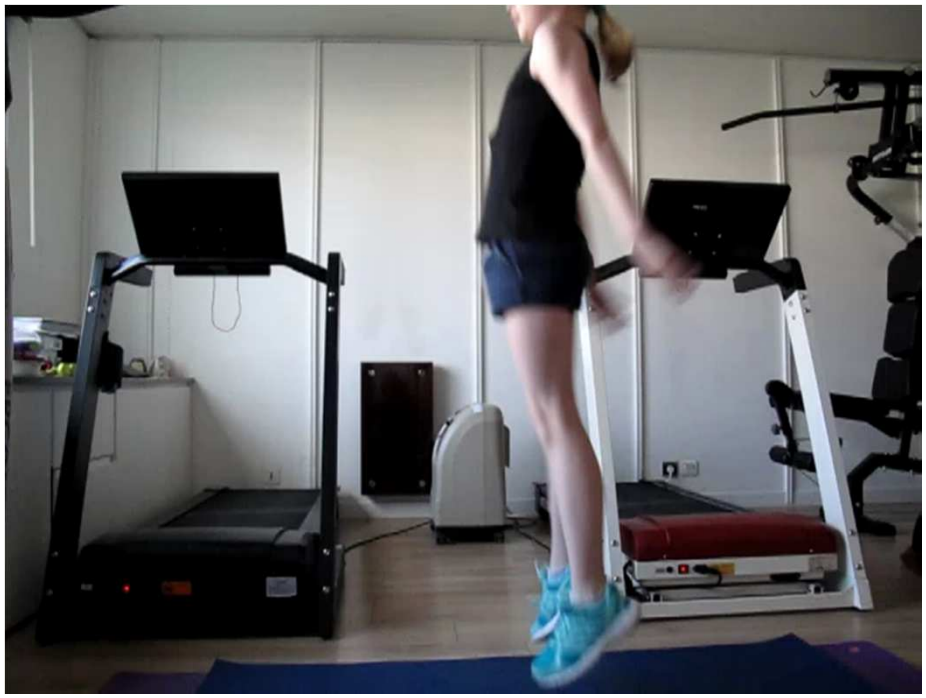
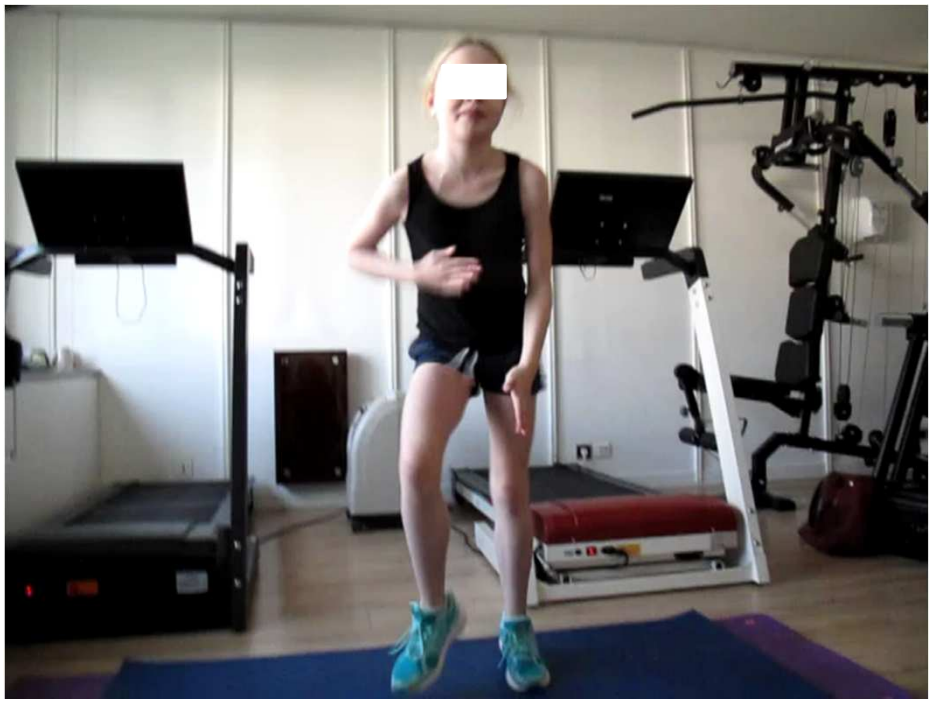
Cas clinique

Exercices physiques à haute intensité





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Cas clinique

Exercices physiques à haute intensité

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Merci pour votre attention !