

Estudio Fisiológico Integral para la Valoración vs
Objetivización de la Intolerancia a la actividad en el
SFC /EM



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IOM Report: Beyond Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome: Redefining an Illness

“Post Exertional Malaise”

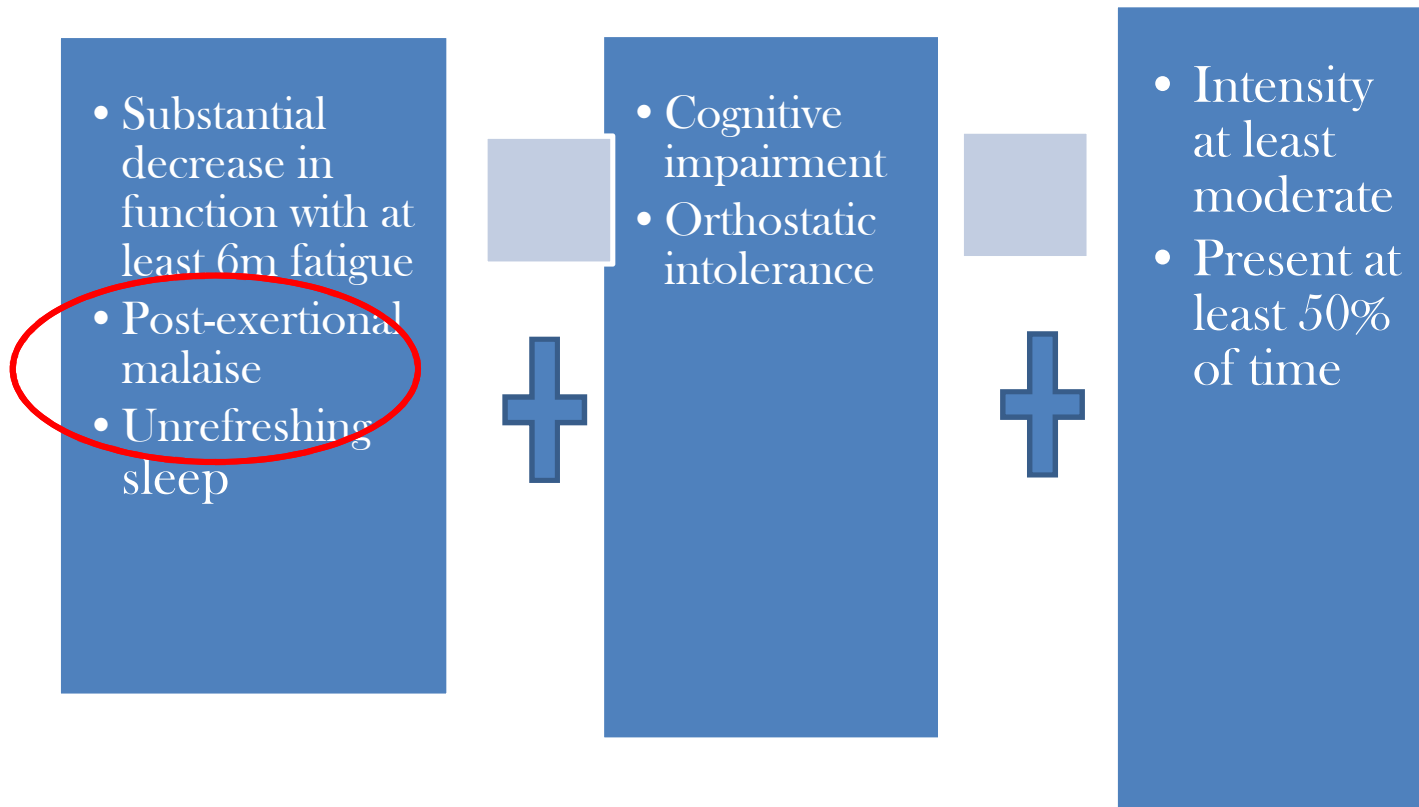


IOM Definition: Required symptoms/ features

3 mandatory symptoms

At least 1 of 2 symptoms

Severity/ Frequency



A New Name for a New Definition: Systemic Exertion Intolerance Disease (SEID)

- 1) Focus on the unusual symptom of PEM
- 2) Emphasize systemic, multi-symptom nature of disease



Objective of 2-day CPET

- **CPET 1:**
 - Measure baseline functional capacity ($\text{VO}_{2\text{peak}}$) and ventilatory (anaerobic) threshold ($\text{VO}_{2@AT}$)
 - Induce PEM
- **CPET 2**
 - Determine if patient can reproduce CPET 1 results
 - Provide evidence of functional impairment

VO₂peak measured directly during CPET is:

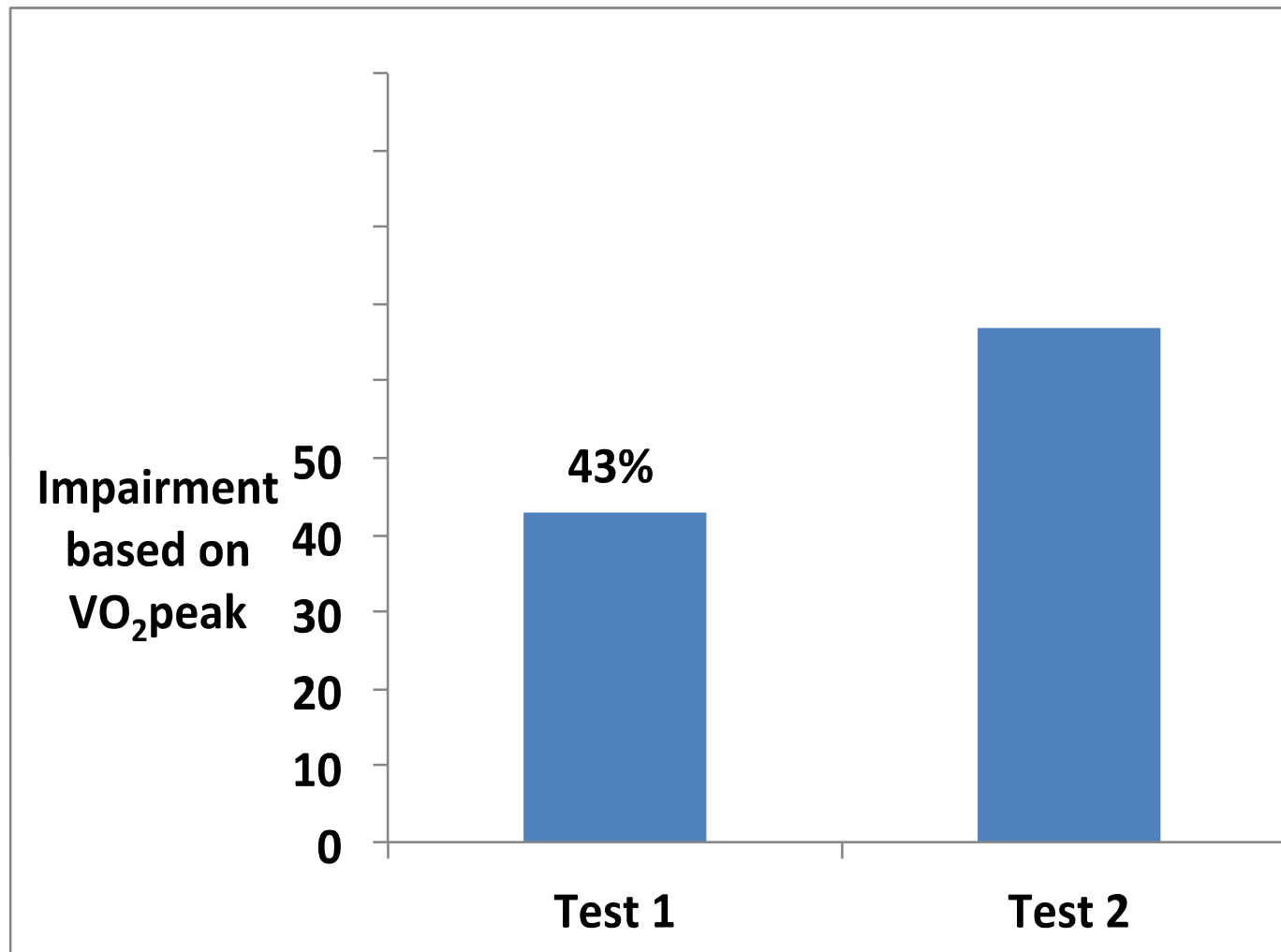
-Valid (Bruce et al., 1973; Taylor et al., 1955)

-Standardized (ACSM, ACC/AHA, ATS/ACCP)

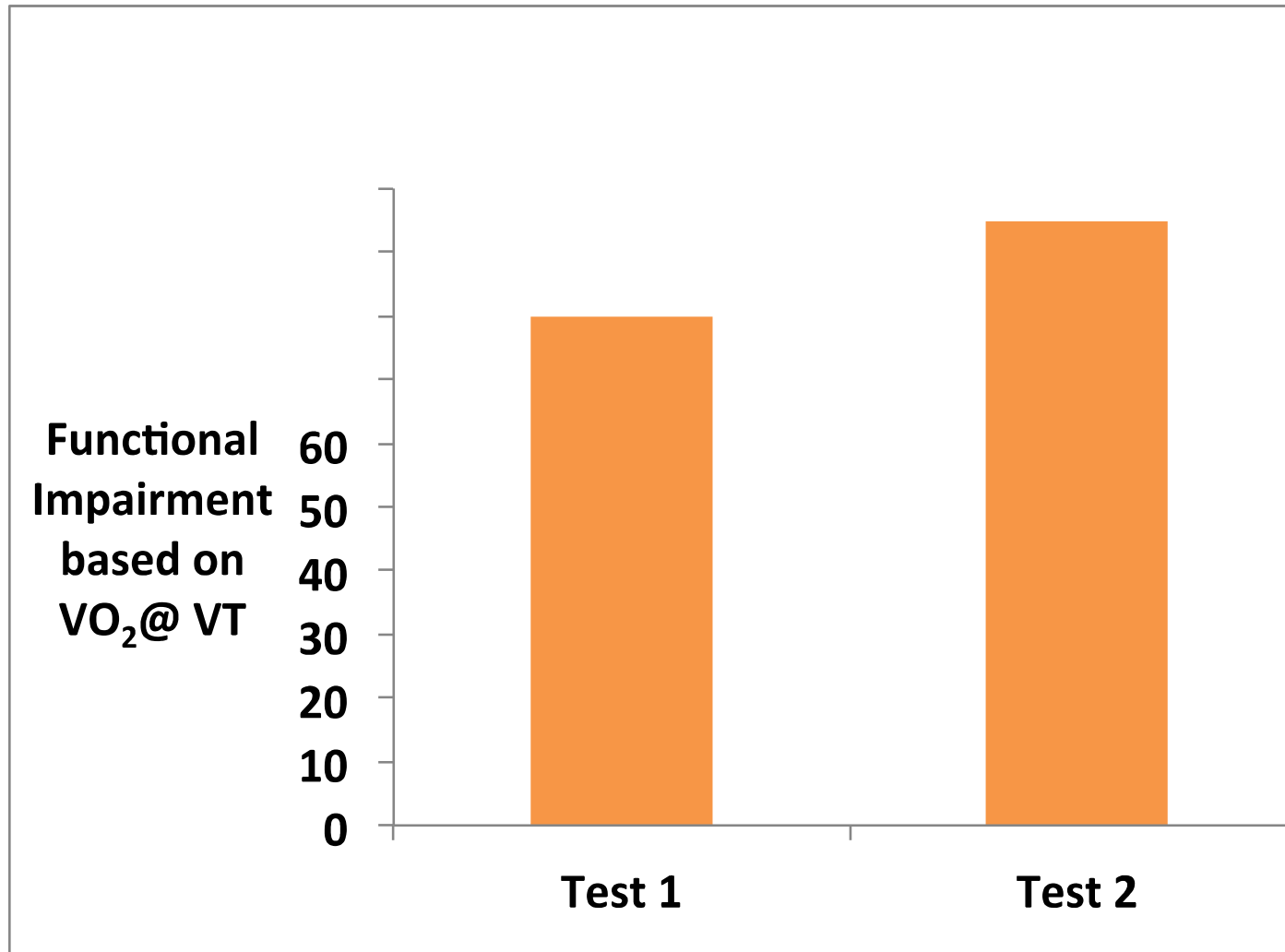
-Reliable in healthy (Taylor et al., 1955; Katch et al. 1982; Weltman et al., 1990) & diseased patients

(Cohen-Solal et al., 1991; Kothmann et al., 2009; Takken et al., 2005; Weber & Janicki, 1985)

**% ME/CFS with functional impairment based on
VO₂peak from 1 CPET and 2 CPETs (N=42)**



**% ME/CFS with functional impairment based on
VO₂@VT from 1 CPET and 2 CPETs**



Criteria for evaluating CPET results

- VO_2 peak - decrease by more than 7% on CPET2
- VO_2 @VAT - decrease by more than 12% on CPET2
- Autonomic dysfunction
 - Chronotropic incompetence - peak HR < 85% age predicted maximum HR
 - Systolic pressure fails to increase 10mmHg/MET
 - Temperature
- Ventilatory dysfunction
 - Abnormal Ve / VCO_2 slope for age/sex
 - Exercise oscillatory breathing- EOB

Metabolic anomaly

TEST 1								TEST 2							
Load	VO2	RER	HR	SBP	DBP	RPE	Ve	Load	VO2	RER	HR	SBP	DBP	RPE	Ve
watts (W)	ml/kg/min		bpm	mmHg	mmHg	6-20	L/min	watts (W)	ml/kg/min		bpm	mmHg	mmHg	6-20	L/min
Rest	6.17	0.74	58	104	60		7.14	Rest	5.07	0.81	84	118	72		7.03
0	7.90	0.76	71	114	84	9	9.64	0	8.00	0.82	87	118	78	11	10.40
25	9.45	0.80	78	116	64	11	10.43	25	11.25	0.81	91	124	78	11	12.79
50	16.45	0.94	103	150	82	15	17.31	50	17.00	1.15	117	154	88	15	20.05
75	20.45	1.03	124	160	88	16	23.24	75	18.05	1.12	138	168	92	18	29.90
100	25.52	1.13	156	170	86	18	32.76	100	19.04	1.10	154	182	80	19	23.66
125								125	1:10 @100W						
150								150							
Immediate Post Exercise				HR = 158				Immediate Post Exercise				HR = 154			
test terminated due to:								test terminated due to:							
volitional fatigue/inability to maintain workload								volitional fatigue/inability to maintain workload							
TOTAL EXERCISE TIME				10:00				TOTAL EXERCISE TIME				9:10			
Recovery	Time	HR	SBP	DBP				Recovery	Time	HR	SBP	DBP			
	1	126	162	70					1	132					
	3	91	122	70					3	102	120	68			
	5	78	102	60					5	80	106	68			
	7								7						
Anaerobic Threshold (AT) @				25 W				Anaerobic Threshold (AT) @				25 W			
	16.1 ml/kg/min	4.6	METS	63	%VO2max				11.75 ml/kg/min	3.4	METS	61	%VO2max		
HR@AT	99							HR@AT	91						
ECG	Resting		NSR					ECG	Resting		NSR				
	Exercise		NSR						Exercise		NSR				

Anaerobic anomaly

TEST 1								TEST 2							
Load	VO2	RER	HR	SBP	DBP	RPE	Ve	Load	VO2	RER	HR	SBP	DBP	RPE	Ve
watts (W) ml/kg/min			bpm	mmHg	mmHg	6-20	L/min	watts (W) ml/kg/min			bpm	mmHg	mmHg	6-20	L/min
Rest	6.00	0.98	66	112	70		11.83	Rest	2.43	1.23	67	110	78		6.75
0	7.90	0.95	83	140	72	11	12.71	0	6.35	1.07	88	128	80	11	13.36
25	9.35	0.95	94	134	82	11	14.75	25	7.95	0.91	95	140	86	12	13.06
50	13.20	1.08	108	156	82	12	23.28	50	10.15	1.09	111	152	88	14	19.04
75	17.10	1.15	129	164	86	14	33.55	75	14.65	1.21	128	168	84	17	31.55
100	19.80	1.27	149	188	86	15	49.04	100	16.75	1.23	144	174	84	18	46.67
125	22.10	1.32	170	194	86	18	68.59	125	21.10	1.29	159	188	84	20	64.77
150								150							
1:00 @ 125W								1:30 @ 125W							
Immediate Post Exercise				HR =	171										
test terminated due to:								test terminated due to:							
volitional fatigue/inability to maintain workload								volitional fatigue/inability to maintain workload							
TOTAL EXERCISE TIME			11:00												
Recovery	Time	HR	SBP	DBP											
	1	160													
	3	112	168	78											
	5	108	142	76											
	7														
Anaerobic Threshold (AT) @				25 W											
9.89 ml/kg/min		2.8	METS	45	%VO2max										
HR@AT		94													
ECG		Resting	NSR												
		Exercise	NSR												

TEST 2								TEST 2							
Load	VO2	RER	HR	SBP	DBP	RPE	Ve	Load	VO2	RER	HR	SBP	DBP	RPE	Ve
watts (W) ml/kg/min			bpm	mmHg	mmHg	6-20	L/min	watts (W) ml/kg/min			bpm	mmHg	mmHg	6-20	L/min
Rest	2.43	1.23	67	110	78		6.75	Rest	2.43	1.23	67	110	78		6.75
0	6.35	1.07	88	128	80	11	13.36	0	6.35	1.07	88	128	80	11	13.36
25	7.95	0.91	95	140	86	12	13.06	25	7.95	0.91	95	140	86	12	13.06
50	10.15	1.09	111	152	88	14	19.04	50	10.15	1.09	111	152	88	14	19.04
75	14.65	1.21	128	168	84	17	31.55	75	14.65	1.21	128	168	84	17	31.55
100	16.75	1.23	144	174	84	18	46.67	100	16.75	1.23	144	174	84	18	46.67
125	21.10	1.29	159	188	84	20	64.77	125	21.10	1.29	159	188	84	20	64.77
150								150							
1:30 @ 125W								1:30 @ 125W							
Immediate Post Exercise				HR =	159										
test terminated due to:								test terminated due to:							
volitional fatigue/inability to maintain workload								volitional fatigue/inability to maintain workload							
TOTAL EXERCISE TIME			11:30												
Recovery	Time	HR	SBP	DBP											
	1	133	164	84											
	3	109	140	78											
	5	95	130	76											
	7	91	130	78											
Anaerobic Threshold (AT) @				0 W											
5.99 ml/kg/min		1.7	METS	28	%VO2max										
HR@AT		92													
ECG		Resting	NSR												
		Exercise	NSR												

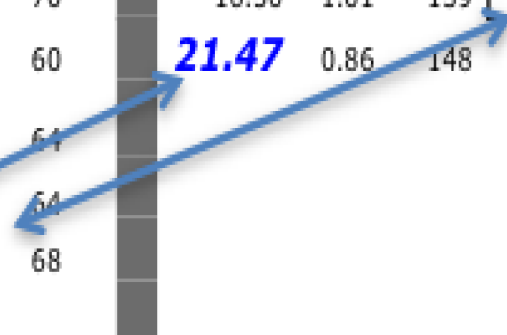
Autonomic dysfunction

TEST 1

WORK watts (W)	VO2 ml/kg/min	RER	HR bpm	SBP mmHg	DBP mmHg
Rest	4.23	0.93	82	102	60
0	6.40	1.29	106	108	60
25	11.10	1.12	110	114	64
50	13.55	0.93	122	119	68
75	19.45	0.91	135	120	70
100	23.90	1.02	144	118	60
125	27.40	1.05	155	140	64
150	32.60	1.12	173	140	64
175	37.30	1.18	186	164	68
200	41.65	1.26	194		

TEST 2

VO2 ml/kg/min	RER	HR bpm	SBP mmHg	DBP mmHg
6.07	0.67	101	100	60
7.10	1.35	112	102	60
10.30	1.10	119	100	60
14.70	1.19	136	90	60
16.50	1.01	139	104	60
21.47	0.86	148		



Criteria for maximal effort

- Was the patient a “*slacker*”?
- Criteria for determining max effort:
 - Objective criteria
 - Leveling off of VO_2 (controversial...still)
 - ± 10 bpm *or* 85-90% of age-predicted max HR (220-age)
(Durstine & Pate, 1988; Howley et al., 1995)
 - $\text{RER} \geq 1.0$ (children/adolescents/older adults) - 1.1 (Holly, 1988; MacDougall et al, 1982)
 - Blood lactate ≥ 8 mM but somewhat variable (Astrand, 1956; Astrand & Rodahl, 1977)
 - Subjective criteria
 - Rating of perceived exertion (RPE) $\geq 18(20)$ (Howley et al., 1995)
 - Rating of perceived exertion (RPE) $\geq 9(10)$ (ACSM, 2014)

Often the best indicator..

- Respiratory Exchange Ratio
 - “Although no one RER value defines maximal effort, values greater than 1.10 are more likely to be associated with near maximal or maximal effort.”

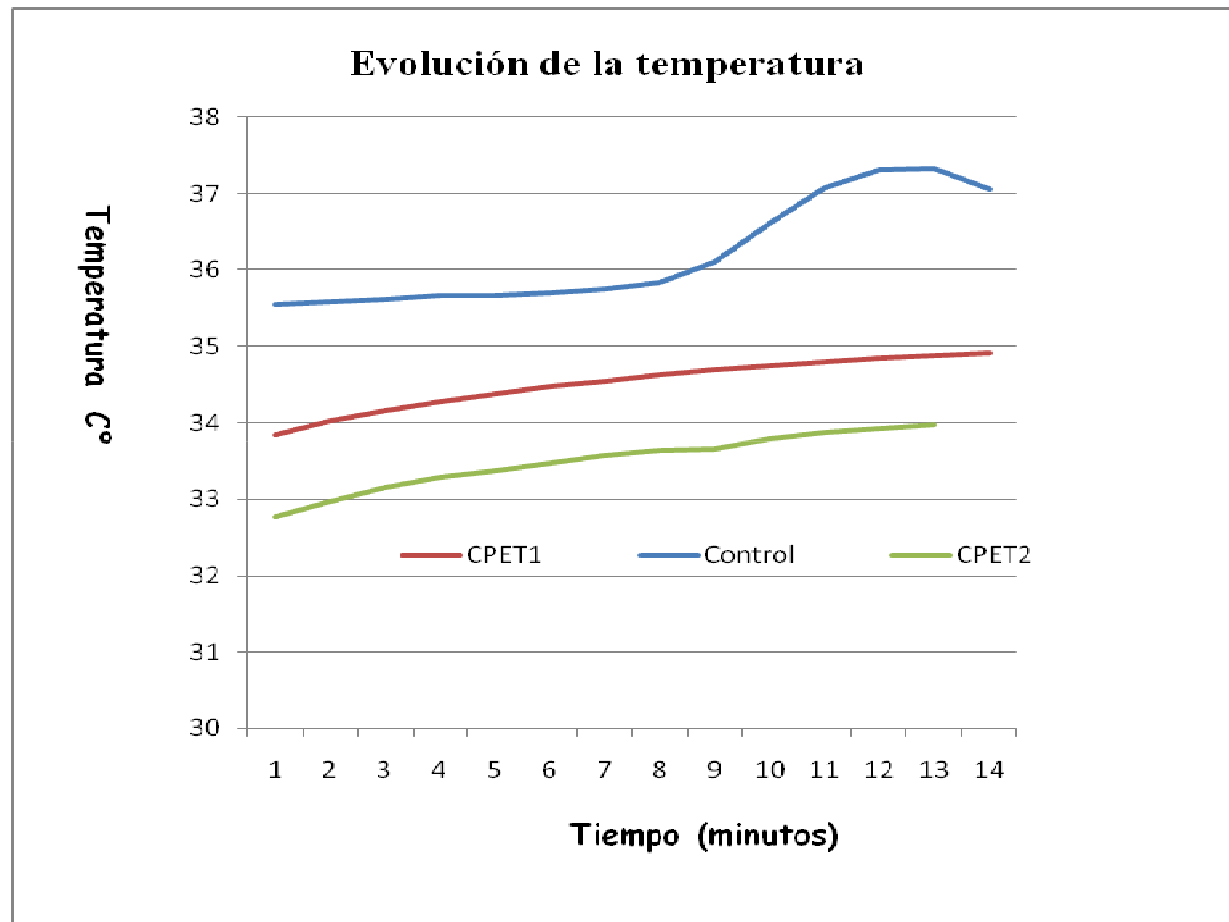
From ATS/ACCP Statement

Cardiac Failure

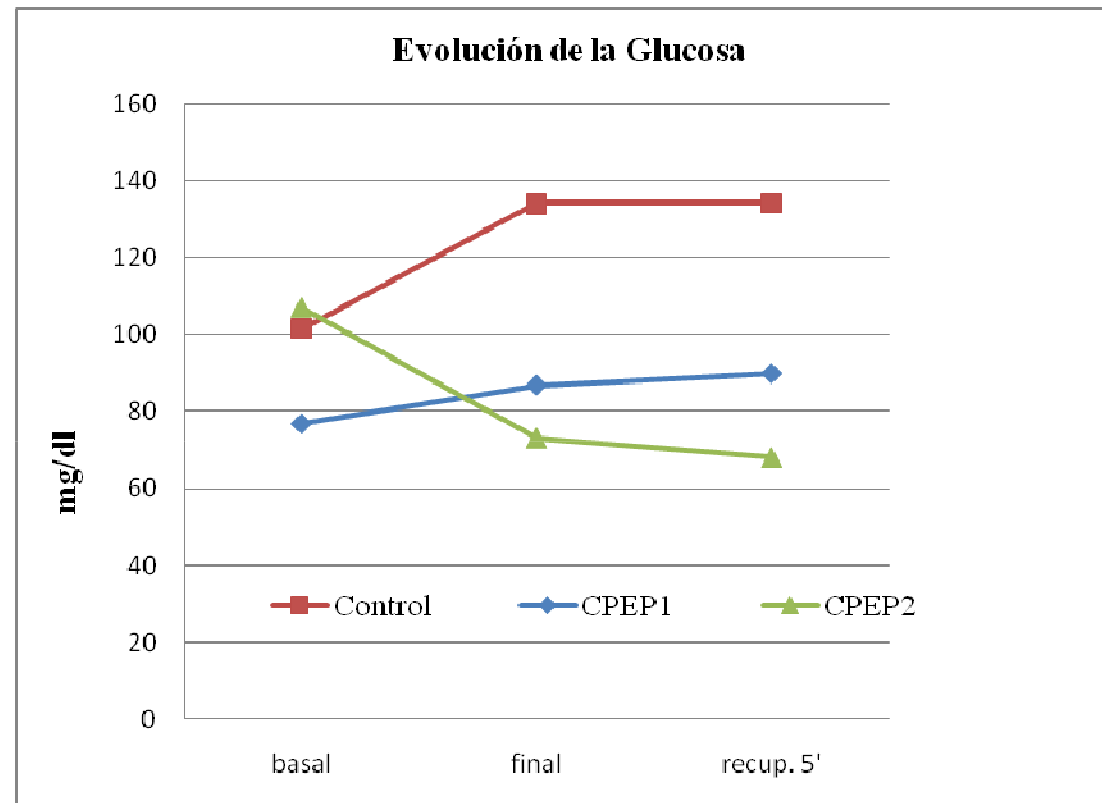
Severity of Impairment	Functional Classification	VO_2max ($\text{ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$)	$\text{VO}_2\text{@AT}$ ($\text{ml}\cdot\text{VO}_2\text{@ATkg}^{-1}\cdot\text{min}^{-1}$)
None - mild	A	>20	>14
Mild - moderate	B	16-20	11-14
Moderate - severe	C	10-15	8-10
Severe	D	<10	<8

Adapted from Weber & Janicki, 1985

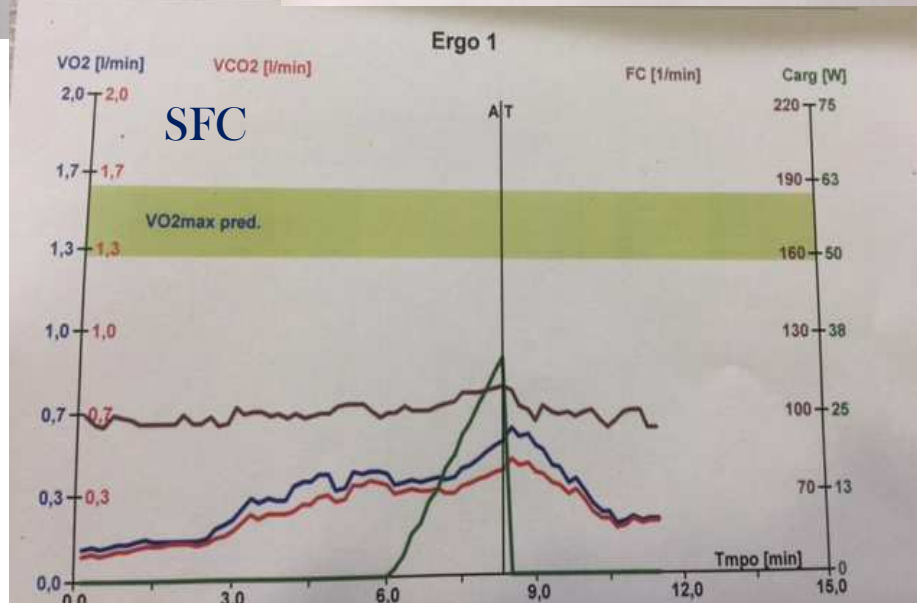
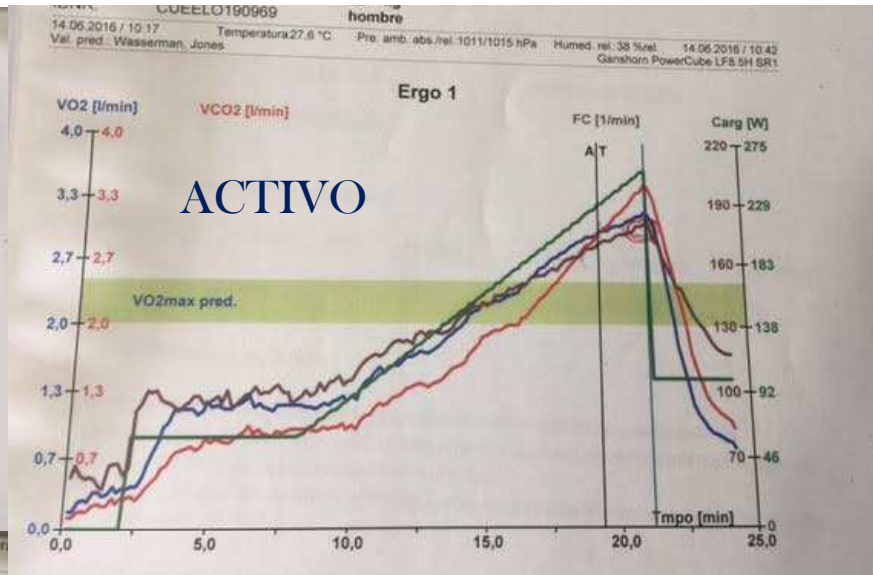
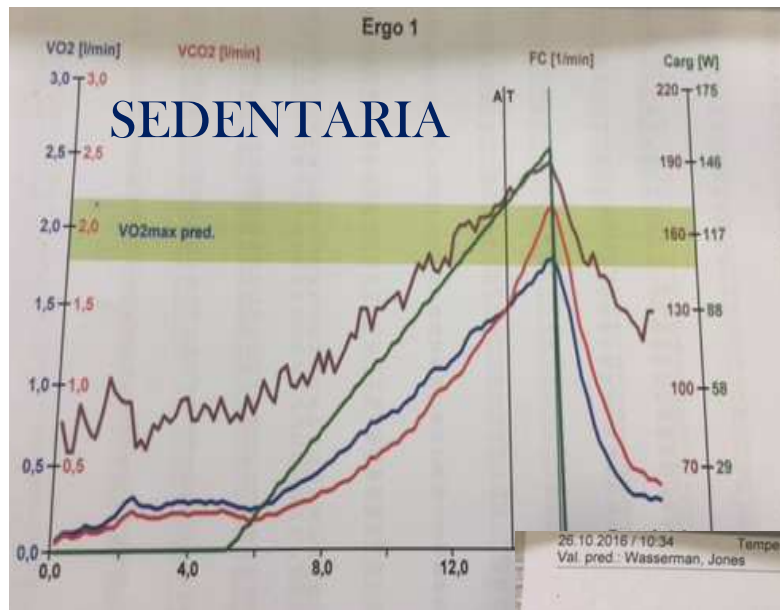
Termo-regulación (Disautonomía del SNA)



Alteración Metabólica



Cardiopulmonary Response



En Conclusión:

Capacidad Funcional es objetivable

Disautonomía del SNA es objetivable

Alteración Metabólica es objetivable

PEM/SFC/EM



SÍ se puede objetivar grado de afectación vs
Serveridad!!!

Qué es un MET?

METS (metabolic equivalent of task)

Unidad de medida del índice metabólico y corresponde a 3,5 ml O₂/kg x min consumo de oxígeno que es lo organismo necesita para mantener sus constantes vitales.



Equivalencias METs-Actividad

Actividad	METS
Dormir. Descansar en posición estirada	1
Automóvil, bus, tren (sentado)	1.5
Moto; bus, tren (de pie)	2
Caminar ligero (4,5 km/h)	3.3
Caminar moderadamente rápido (5,3 km/h)	3.8
Caminar rápido (6,4 km/h) 5,0	5
Correr (8,4 km/h) 9,0	9
Correr (9,6 km/h)	10

Equivalencias METs-Actividad

Actividad	METS
Natación	4
Yoga/estiramientos	3.5
Gimnasio ligero	4
Actividad laboral sedentaria	2-3
Actividad laboral ligera de pie (oficina, supervisión..)	2-5
Trabajo manual ligero	3-5
Trabajo manual moderado	5-7
Trabajo intenso	6-15



Gracias por su atención!!

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