COVID et Sport

Il n’y a pas que le cœur…

b.aguilaniu@gmail.com

Cœur et Sport
Renne 5-6 Mai 2022

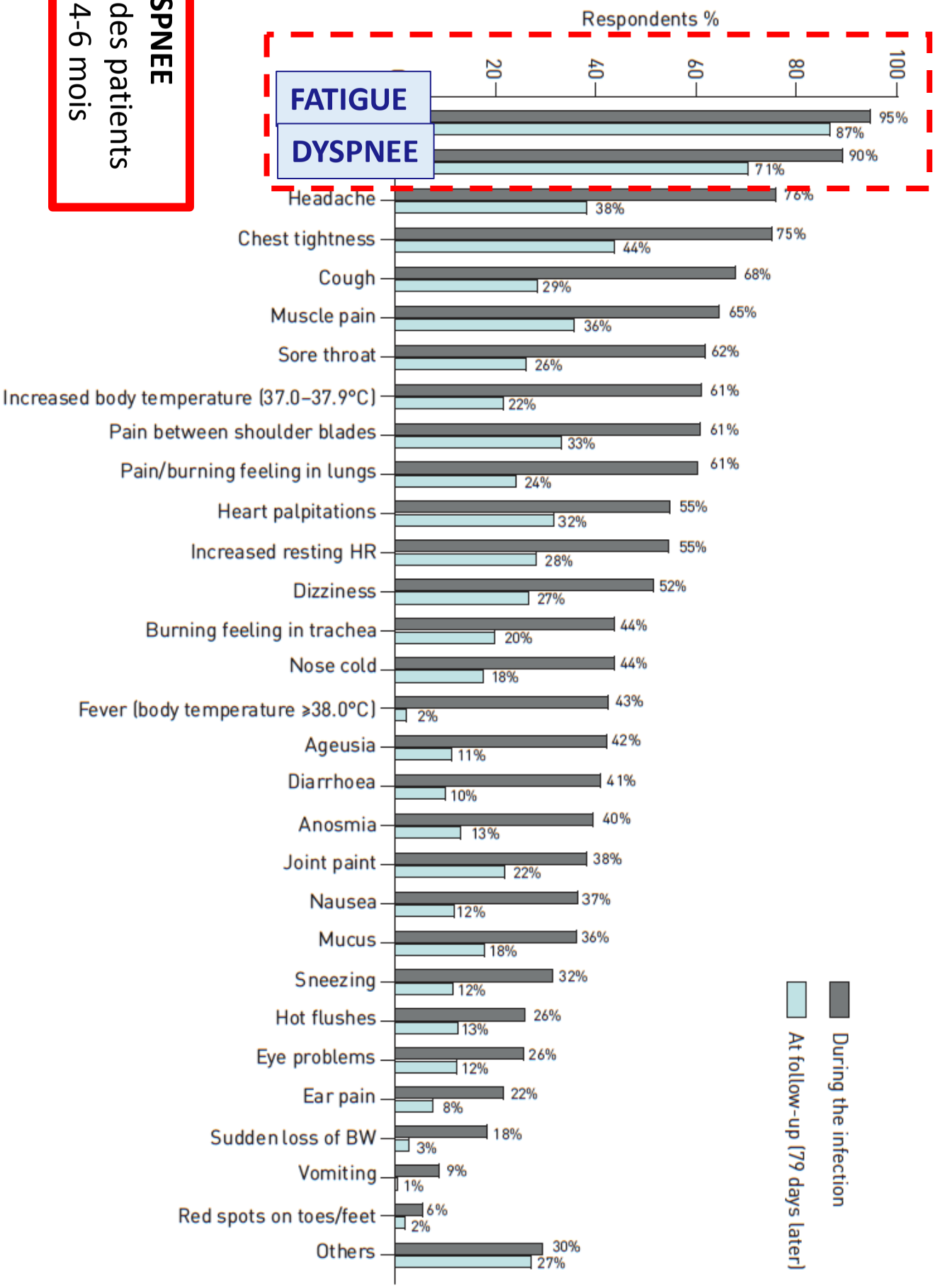
Persistent symptoms 3 months after a SARS-CoV-2 infection: the post-COVID-19 syndrome?

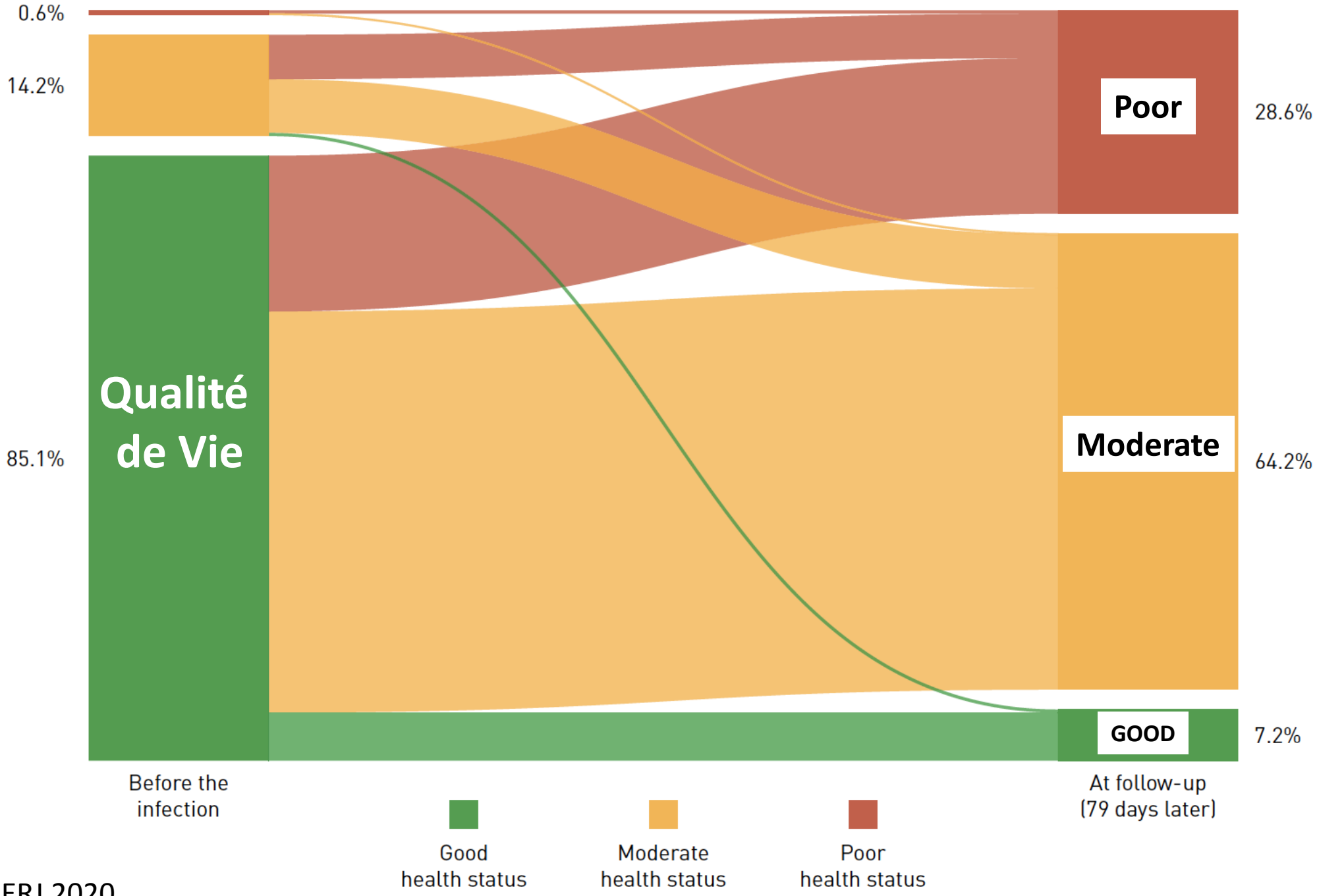
ERJ Open Res 2020;

Yvonne M.J. Goërtz[1,2,3,9], Maarten Van Herck[1,2,3,4,9], Jeannet M. Delbressine[1], Anouk W. Vaes[1], Roy Meys[1,2,3], Felipe V.C. Machado[1,2,3], Sarah Houben-Wilke[1], Chris Burtin[4], Rein Posthuma[1,2,3], Frits M.E. Franssen[1,2,3], Nicole van Loon[1,5], Bita Hajian[1,2,3], Yvonne Spies[6], Herman Vijlbrief[6], Alex J. van 't Hul[7], Daisy J.A. Janssen[1,8] and Martijn A. Spruit[1,2,3,4]

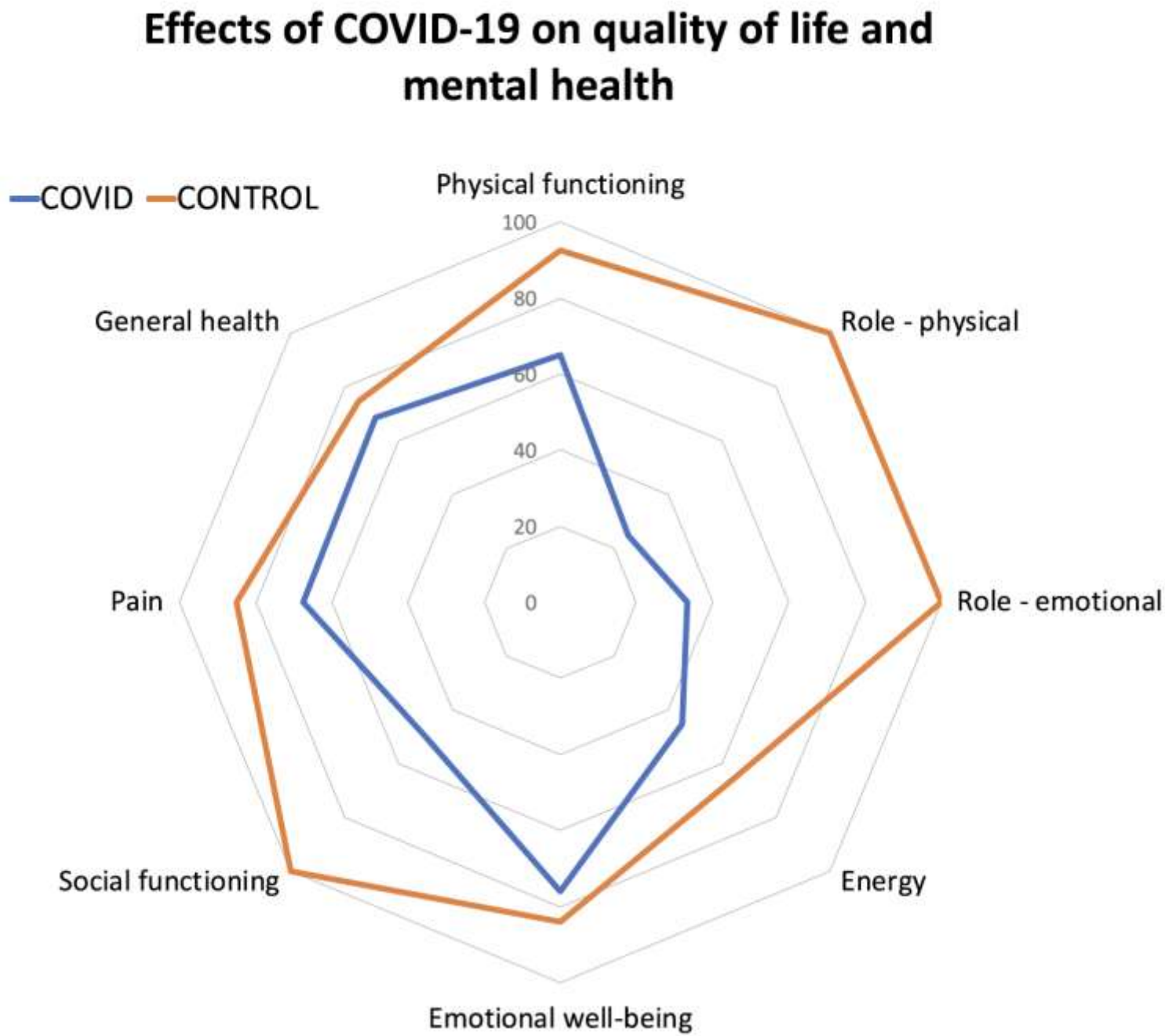
DYSPNEE

Env. 20% des patients entre 4-6 mois

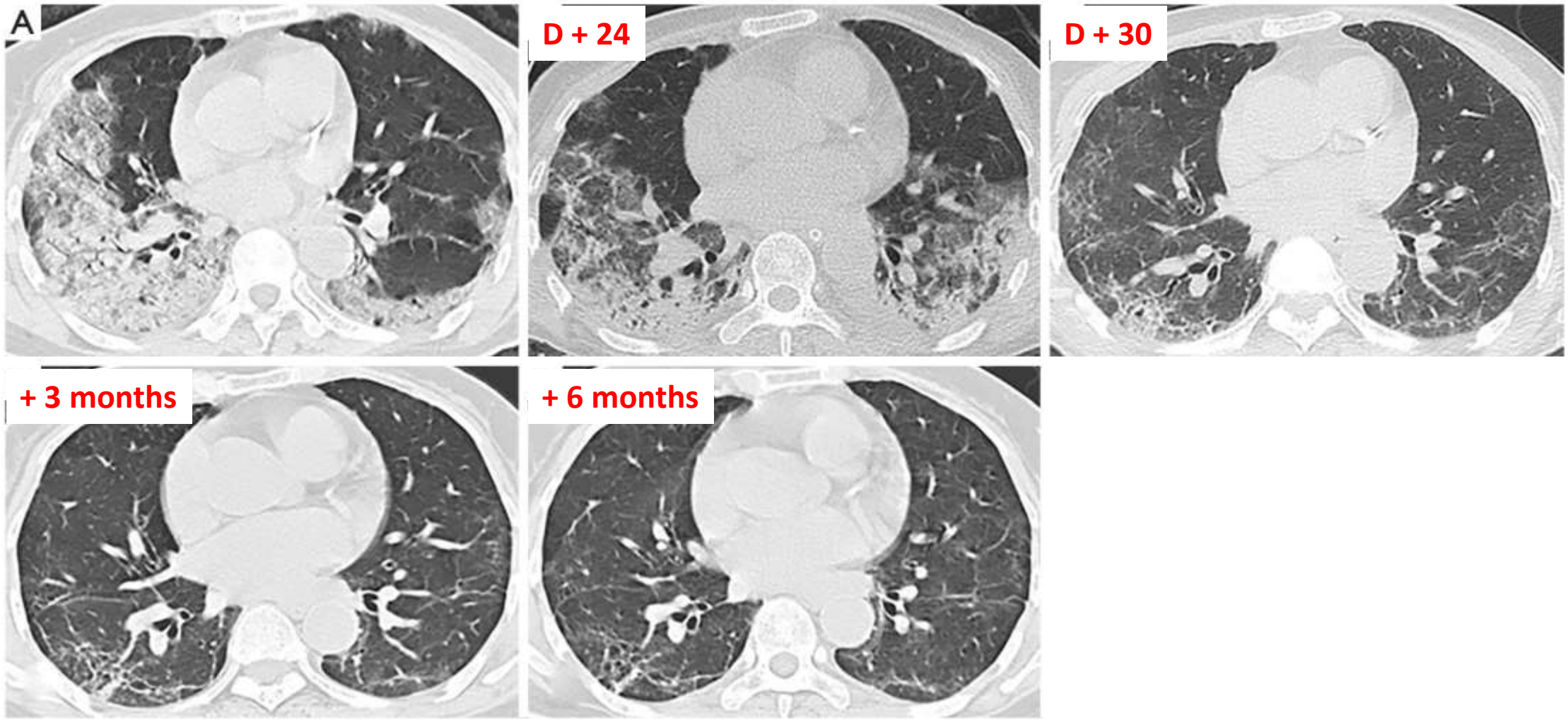


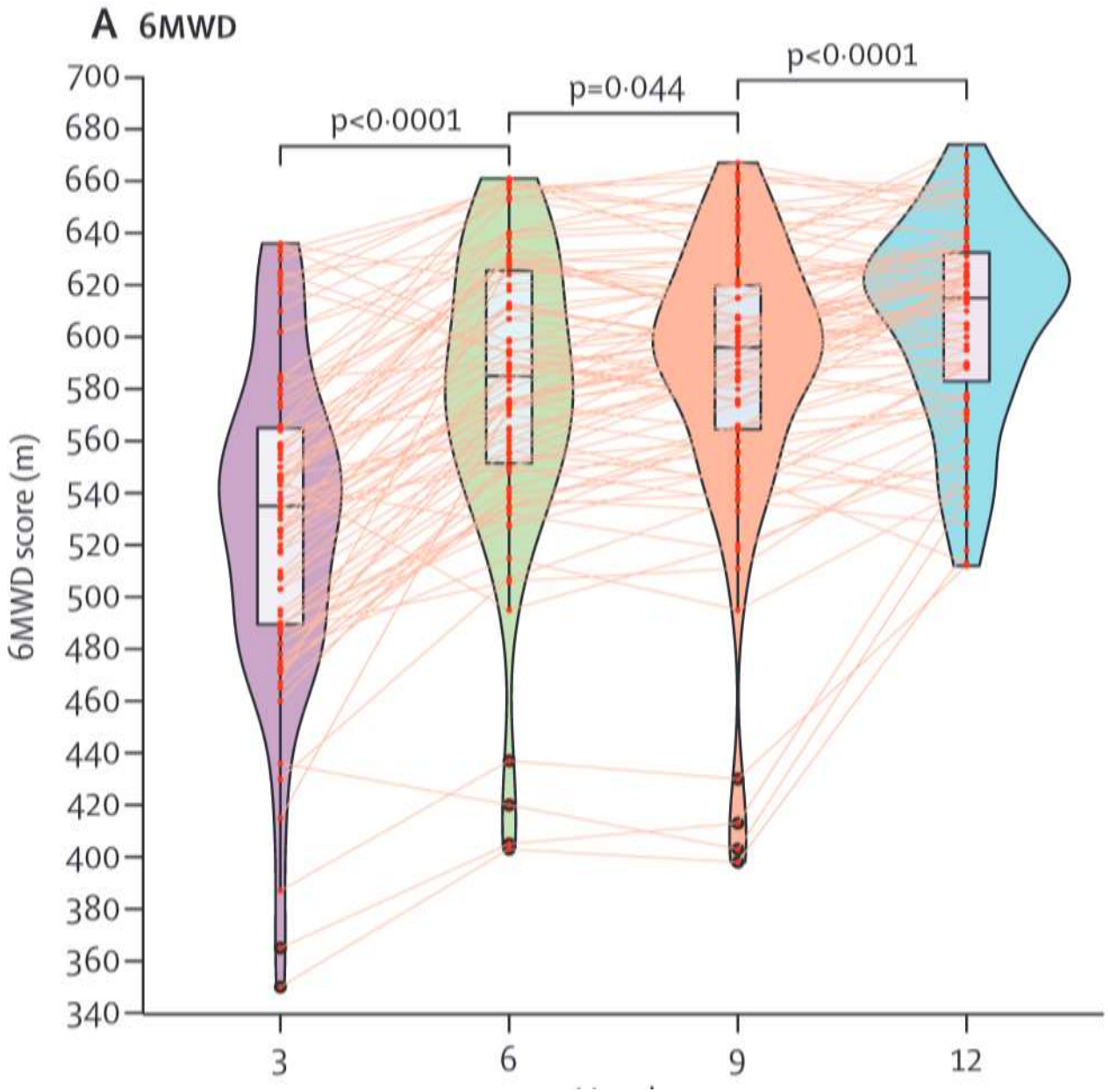


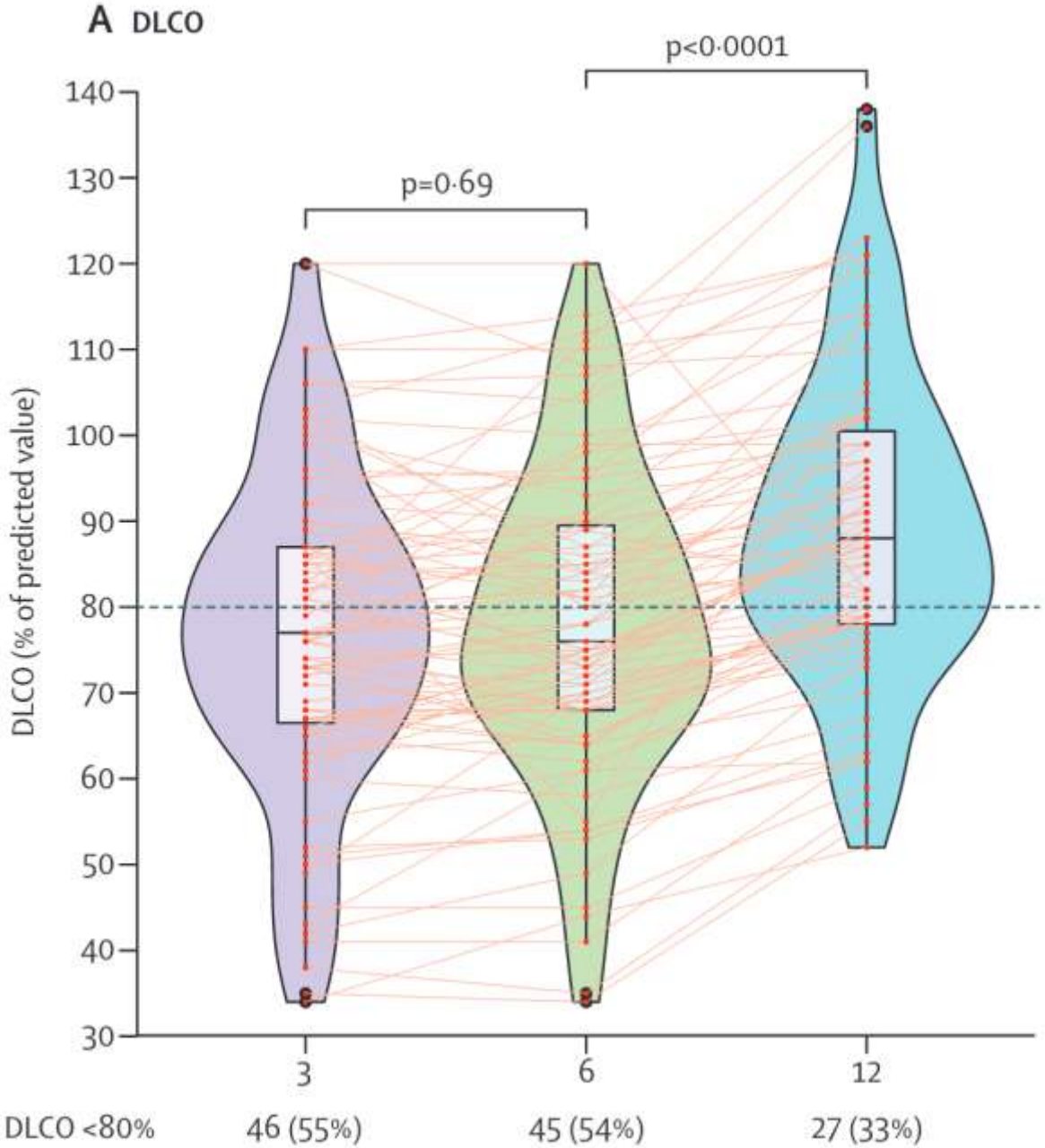
Goërtz et al. ERJ 2020


Effects of COVID-19 on quality of life and mental health
COVID
CONTROL
Physical functioning
Role - physical
Role - emotional
Energy
Emotional well-being
Social functioning
Pain
General health
100
80
60
40
20
0

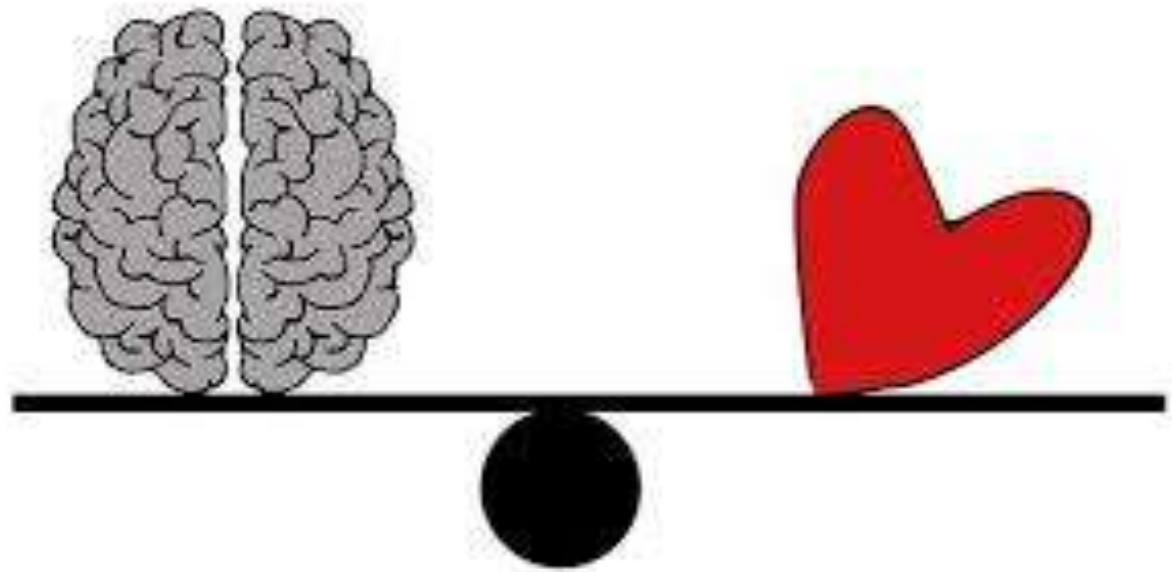
KNOCK
OU LE TRIOMPHE DE LA MEDECINE
pièce en 3 actes de M. JULES ROMAINS
mise en scène de
LOUIS JOUVET
Becan
COMEDIE
DES
CHAMPS
ELYSÉES
DIRECTION JACQUES HEBERTOT


A
D + 24
D + 30
+ 3 months
+ 6 months





WU et al Lancet Respir Med 2021



STATE-OF-THE-ART REVIEW

The Pathogenesis and Long-Term Consequences of COVID-19 Cardiac Injury

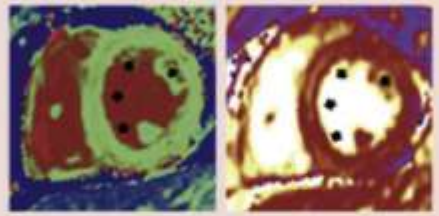
JACC 2022

Bhurint Siripanthong, BA,[a,*] Babken Asatryan, MD, PhD,[b,*] Thomas C. Hanff, MD, MSCE,[c] Salman R. Chatha, MBBS, MSc,[d,e] Mohammed Y. Khanji, MBBCh, PhD,[d,f,g] Fabrizio Ricci, MD, PhD, MSc,[h,i,j] Daniele Muser, MD, PhD,[k] Victor A. Ferrari, MD,[l,m] Saman Nazarian, MD, PhD,[n] Pasquale Santangeli, MD, PhD,[n] Rajat Deo, MD, MTR,[n] Leslie T. Cooper, Jr, MD,[o] Saidi A. Mohiddin, MBChB, MD,[d,g] C. Anwar A. Chahal, MBChB, PhD[d,n,p,q]

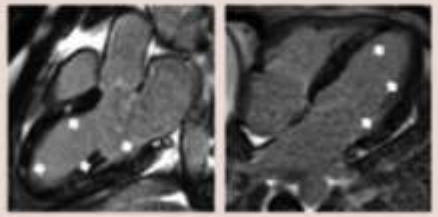
Long-Term Consequences of COVID-19 Cardiac Injury

Structural

- Persistent T1 and T2 abnormalities on CMR
  - fibrosis and myocardial edema



- Ongoing myocardial inflammation on LGE



- Thrombogenesis and systemic embolism (e.g., stroke)

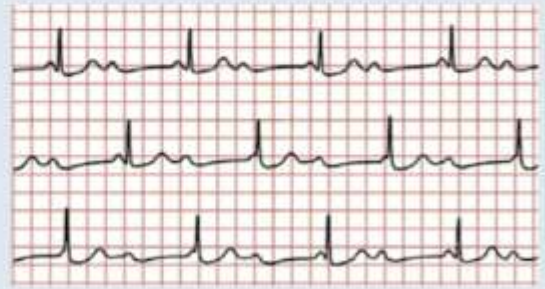
LVEF ↓

LV volume ↑

Functional

- New-onset arrhythmias (e.g., atrial fibrillation)

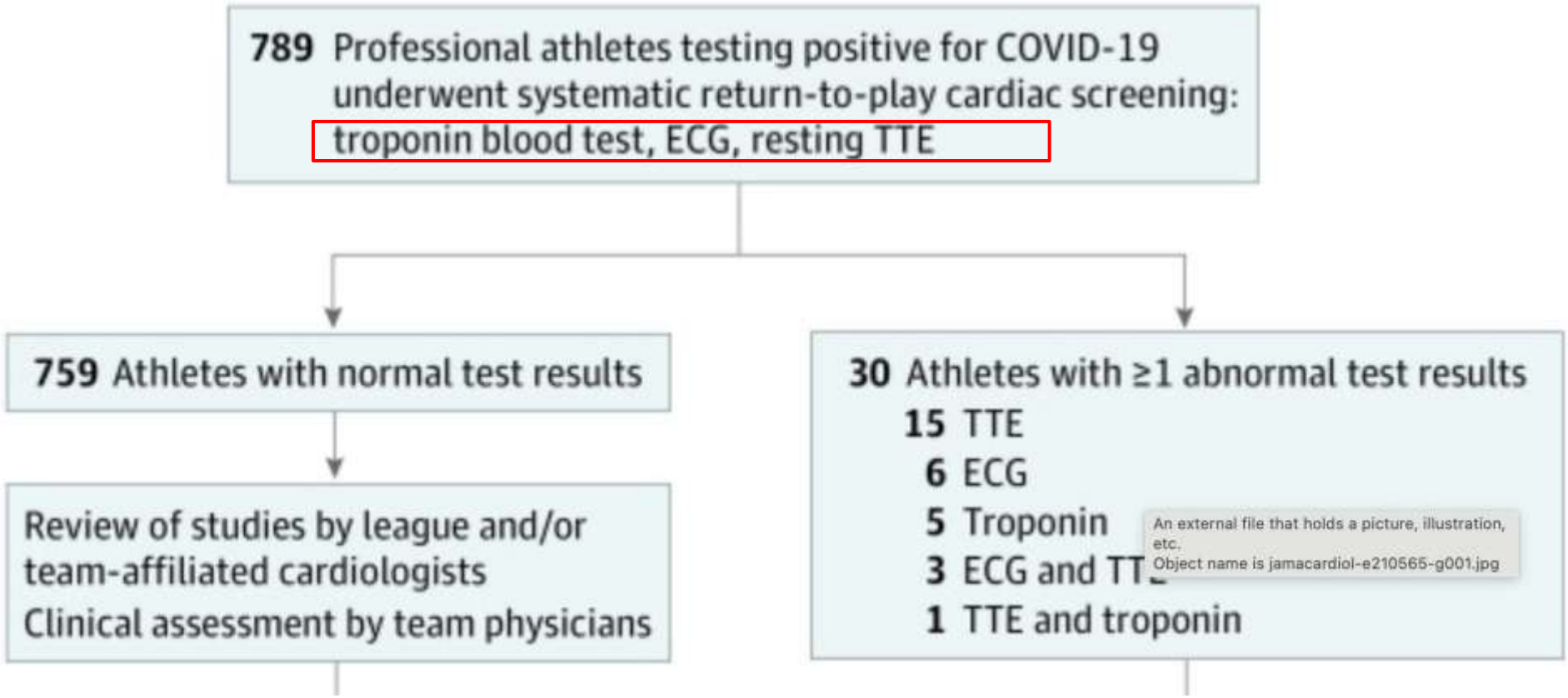
- Complete heart block



? Myocardial fitness and risk of sudden cardiac death in returning athletes

JAMA Cardiol. 2021 Jul; 6(7): 1–8.
Published online 2021 Mar 4. doi: 10.1001/jamacardio.2021.0565
PMCID: PMC7934073
PMID: 33662103

Prevalence of Inflammatory Heart Disease Among Professional Athletes With Prior COVID-19 Infection Who Received Systematic Return-to-Play Cardiac Screening



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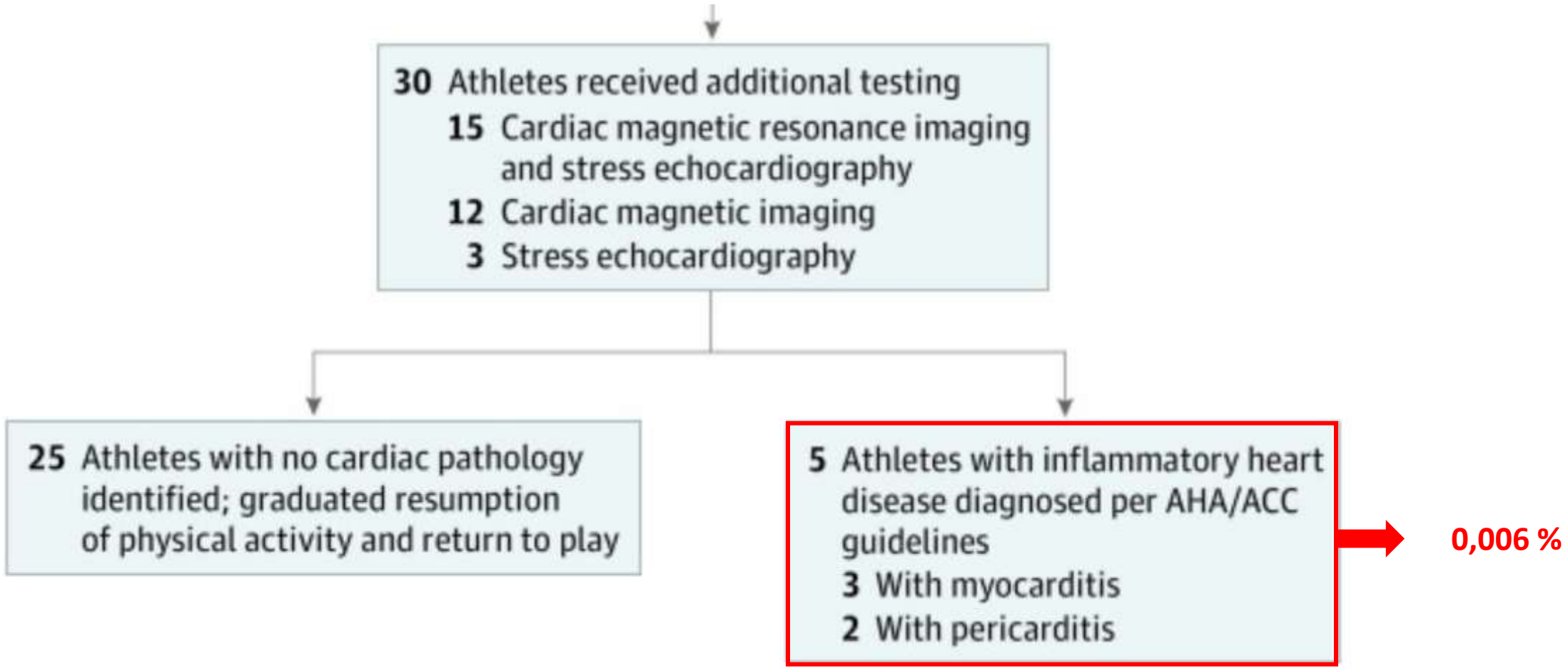


International Journal of
Environmental Research and Public Health

MDPI

Article

NO

Impact of COVID-19 on the Preparation for the Tokyo Olympics: A Comprehensive Performance Assessment of Top Swimmers

Table 1. Baseline characteristics according to COVID-19 infection.

	Non-COVID Swimmers (n = 32)	COVID Swimmers (n = 14)	P
Age (years)	24.2 ± 4.4	23 ± 3.8	0.40
Female (n, %)	14 (43.8%)	7 (50%)	0.70
Sports experience (years)	17.8 ± 4.5	16.8 ± 3.9	0.44
Pre-COVID training hours/week	24 ± 4.5	24.5 ± 3.9	0.71
Post-COVID training hours/week	24 ± 4.5	24.5 ± 3.9	0.71
Missed training days	18.5 ± 3.4	19 ± 6	0.76

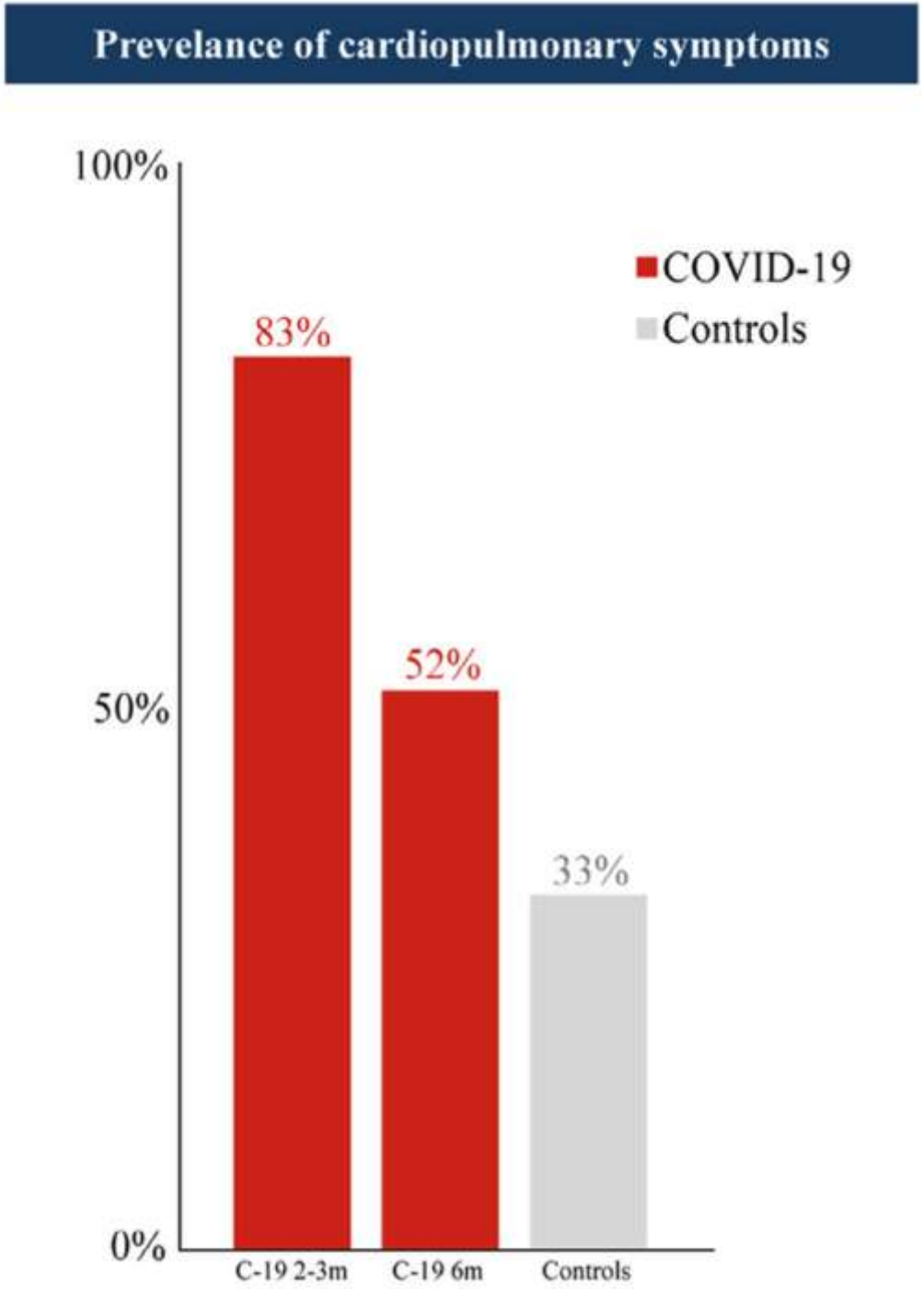
Research paper

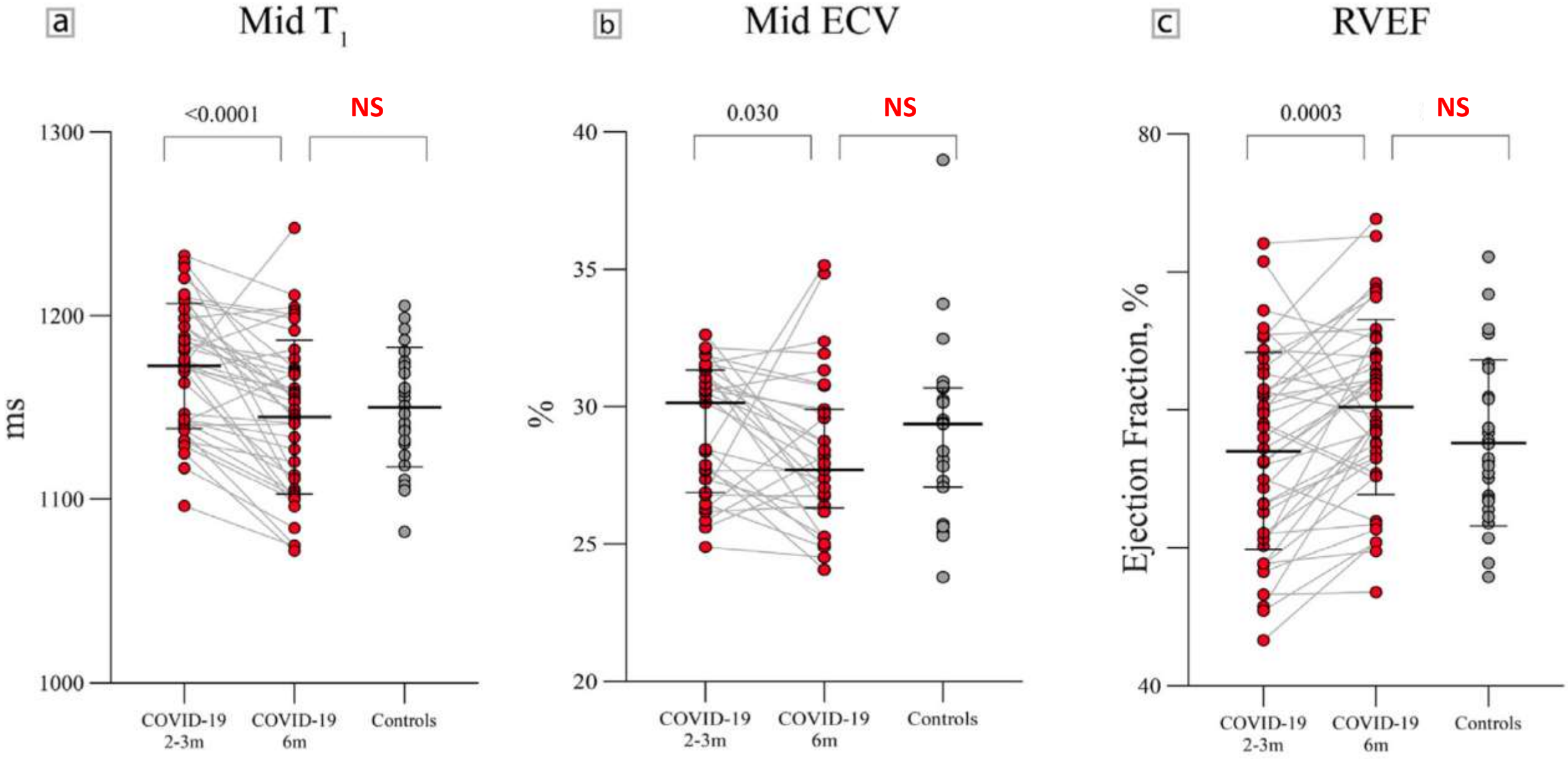
Symptom Persistence Despite Improvement in Cardiopulmonary Health – Insights from longitudinal CMR, CPET and lung function testing post-COVID-19

56 sujets hospitalisés pour COVID
30 controls
48 suivis

At 3 MONTHS:
Symptom-questionnaires
Cardiac resonance imaging (CMR)
Native cardiac T1 (marker of fibroinflammation)
Late gadolinium enhancement (LGE, marker of focal fibrosis
Lung CMR/ CT
Cardiopulmonary exercise test (CPET),
Spirometry

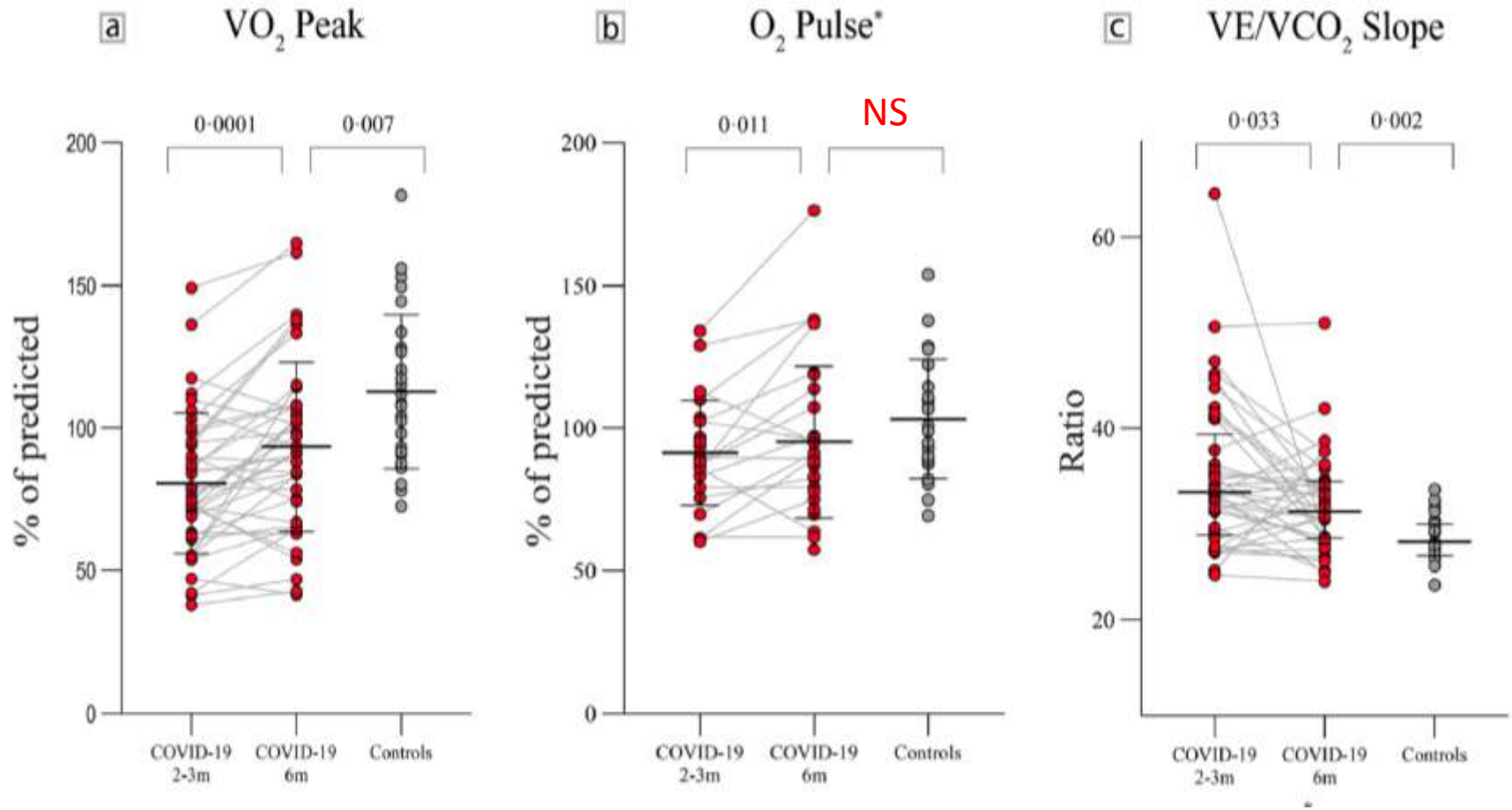
Chest pain,
Palpitations
Syncope
Dyspnoea,
Dizziness

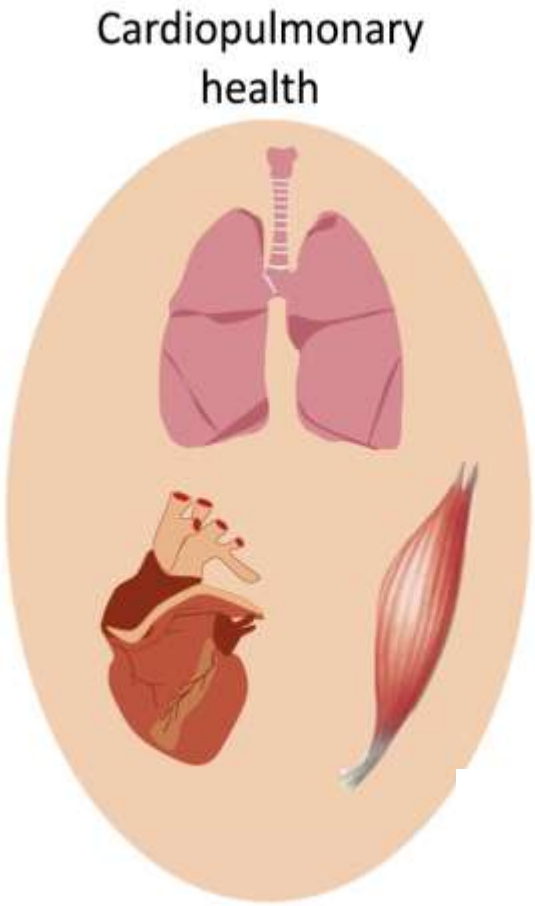



a
Mid T1
<0.0001
NS
1300
1200
1100
1000
ms
COVID-19 2-3m
COVID-19 6m
Controls
b
Mid ECV
0.030
NS
40
35
30
25
20
%
COVID-19 2-3m
COVID-19 6m
Controls
c
RVEF
0.0003
NS
80
40
Ejection Fraction, %
COVID-19 2-3m
COVID-19 6m
Controls

Research paper

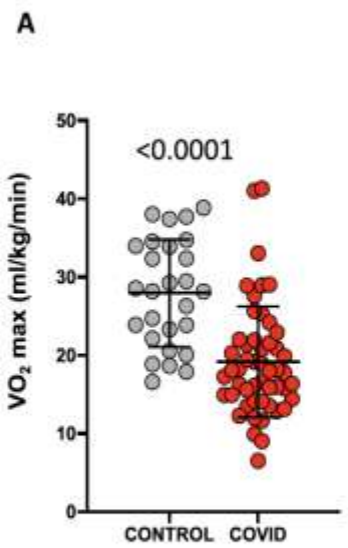
Symptom Persistence Despite Improvement in Cardiopulmonary Health – Insights from longitudinal CMR, CPET and lung function testing post-COVID-19

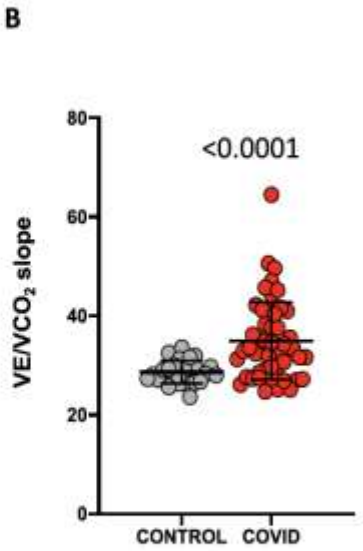




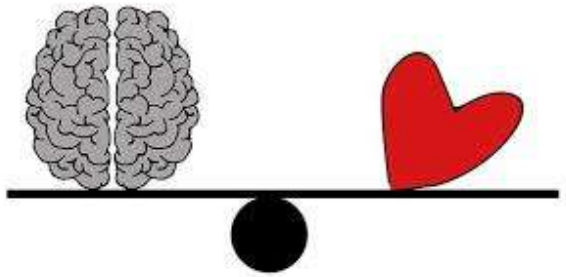
VO_2 plus faible

HV plus marquée





Dysautonomia following COVID-19 is not associated with subjective limitations or symptoms but is associated with objective functional limitations



Peter Ladlow, PhD,*† Oliver O'Sullivan, MRCP,* Andrew Houston, MSc,*

HEART RYTHM 2021

Env. 6 mois Post COVID

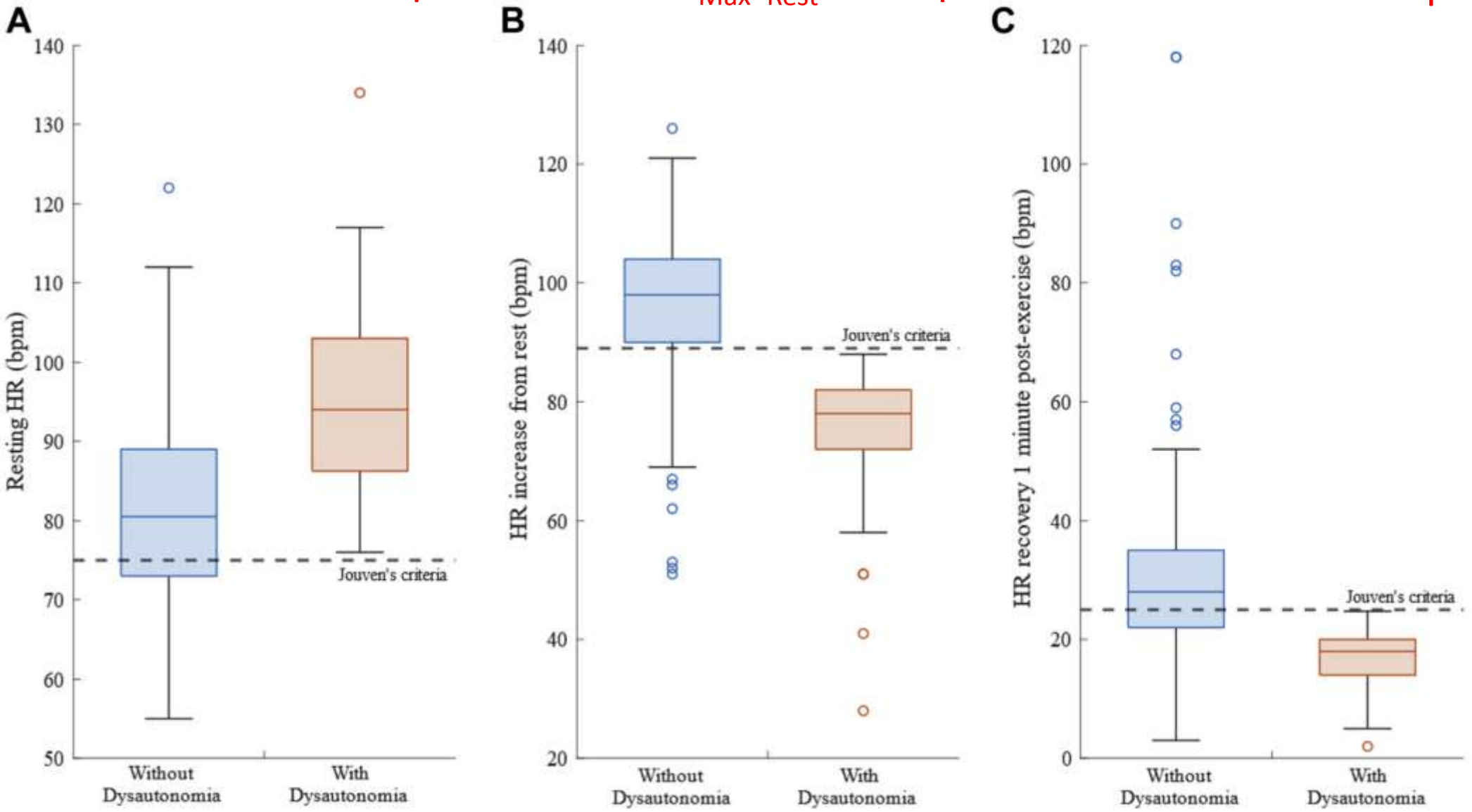
205 militaires > 51 classés Dysautonomie (25%)

Variable	All patients (N = 205)	Without dysautonomia (n = 154)	With dysautonomia (n = 51)	Stat	*P* value
Sex (M/F)	172/33	129/25	43/8	0.009†	.927
Age (y)	38 ± 10	37 ± 10	43 ± 9	−4.053‡	**<.001***
Height (cm)	177 ± 8	177 ± 9	177 ± 7	0.443‡	.658
Body mass (kg)	90 ± 17	89 ± 17	94 ± 16	−1.645‡	.101
BMI (kg/m^2)	29 ± 4	28 ± 4	30 ± 4	−2.520‡	**.013***
Waist circumference (cm)	95 ± 13	94 ± 13	100 ± 12	−2.989‡	**.003***

Rest HR ≥ 75 bpm

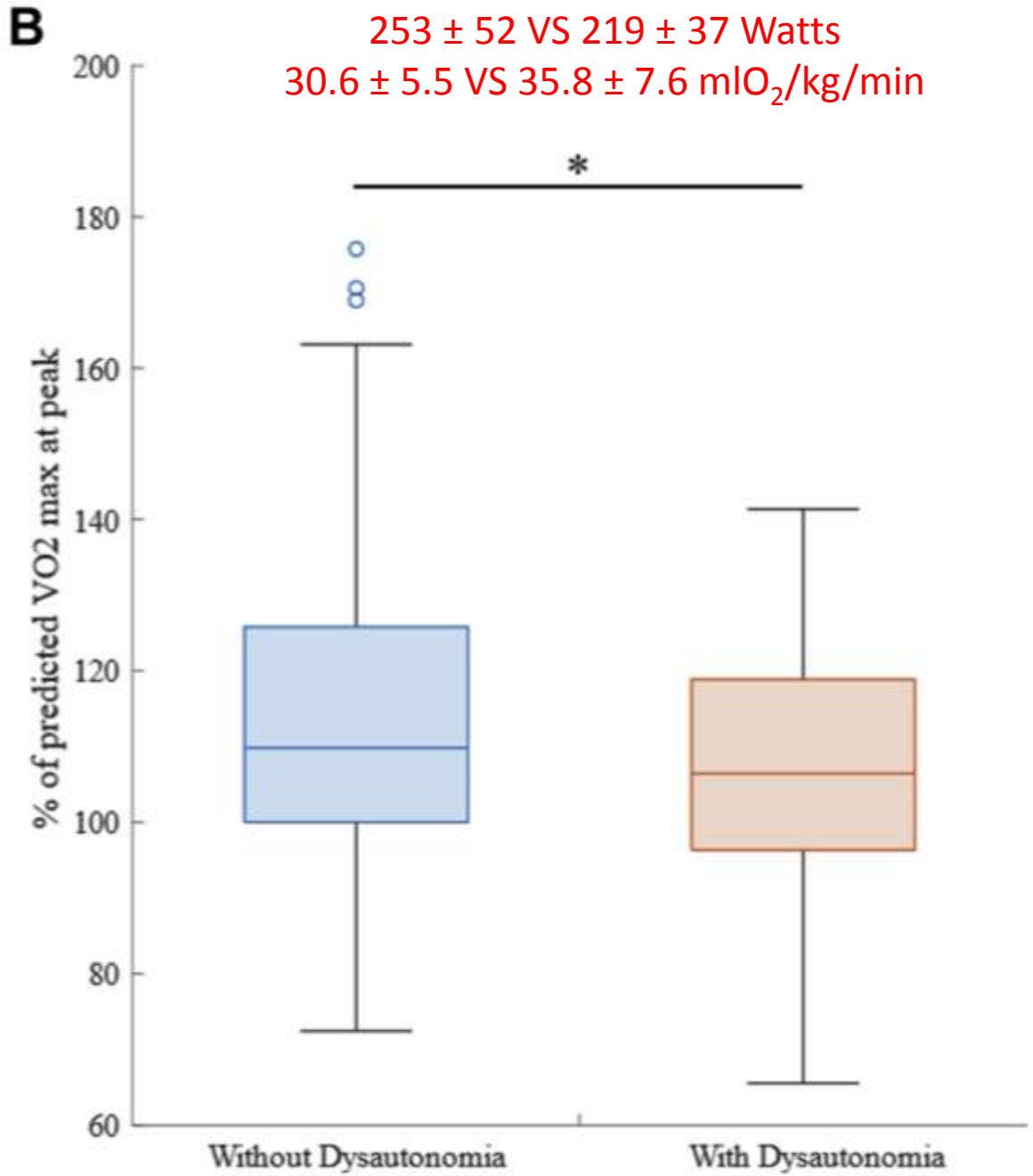
$\Delta HR_{Max-Rest} < 89$ bpm

ΔHR at 1’ < 25 bpm



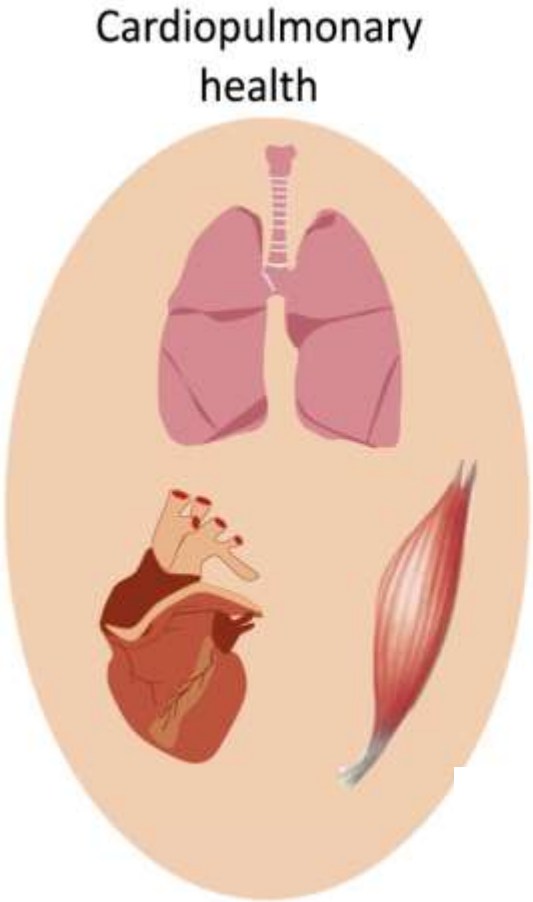
253 ± 52 VS 219 ± 37 Watts

30.6 ± 5.5 VS 35.8 ± 7.6 mlO_2/kg/min



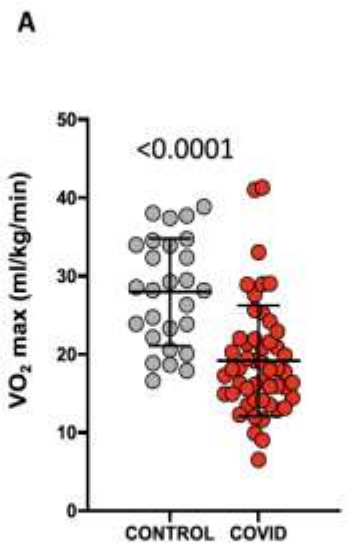
VENTILATION

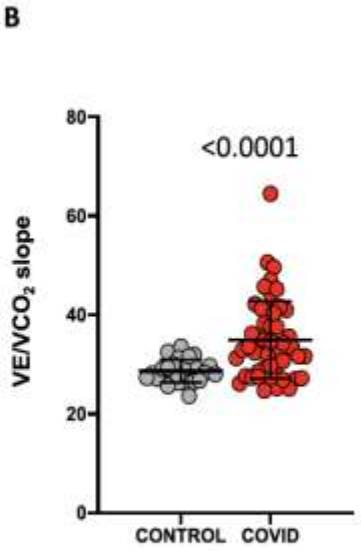
Variable	All patients (n = 205)	Without dysautonomia (n = 154)	With dysautonomia (n = 51)	*t*	*P* value
Ventilation					
BF at rest (breaths/min)	16 ± 5	16 ± 4	18 ± 5	−2.756	**.006**†
BF at VT1 (breaths/min)	20 ± 6	19 ± 5	23 ± 6	−3.609	**<.001**‡
BF at peak (breaths/min)	47 ± 9	46 ± 9	48 ± 9	−1.234	.219
$\dot{V}E/\dot{V}co_2$ at rest	30.2 ± 4.3	29.8 ± 4.3	31.3 ± 4.2	−2.107	**.036***
$\dot{V}E/\dot{V}co_2$ at VT1	26.6 ± 3.4	26.1 ± 3.2	28.0 ± 3.7	−3.462	**.001**†
$\dot{V}E/\dot{V}co_2$ at peak	33.7 ± 7.7	32.7 ± 4.7	36.4 ± 12.9	−2.973	**.003**†
$\dot{V}E/\dot{V}co_2$ slope	28.3 ± 4.8	27.7 ± 4.7	29.9 ± 4.9	−2.839	**.005**†
pco_2 rest	5.0 ± 0.6	5.0 ± 0.5	5.0 ± 0.8	0.037	.970
pco_2 peak	4.4 ± 0.8	4.4 ± 0.8	4.2 ± 0.6	1.191	.235



VO_2 plus faible

HV plus marquée





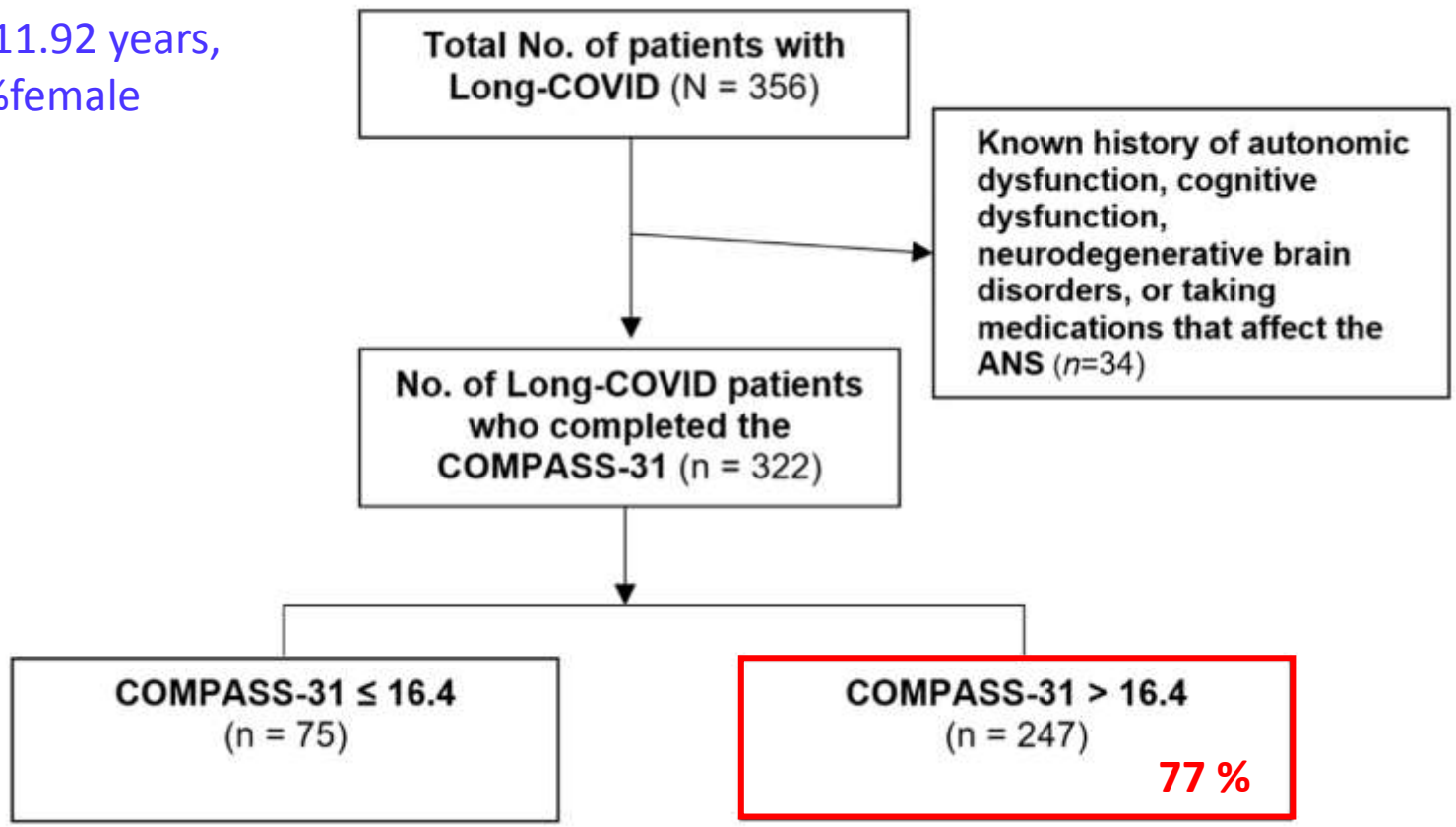
ANNALS of Clinical and Translational Neurology
Open Access
AMERICAN NEUROLOGICAL ASSOCIATION

RESEARCH ARTICLE

Prevalence and patterns of symptoms of dysautonomia in patients with long-COVID syndrome: A cross-sectional study

Ahmed M. Eldokla[1,2], Aliae A. Mohamed-Hussein[3], Ahmed M. Fouad[4], Mariam G. Abdelnaser[5], Sara T. Ali[1], Nahed A. Makhlouf[6], Islam G. Sayed[5], Hoda A. Makhlouf[3], Jaffer Shah[7] & Hani Aiash[8,9]

35.92 ± 11.92 years,
73%female

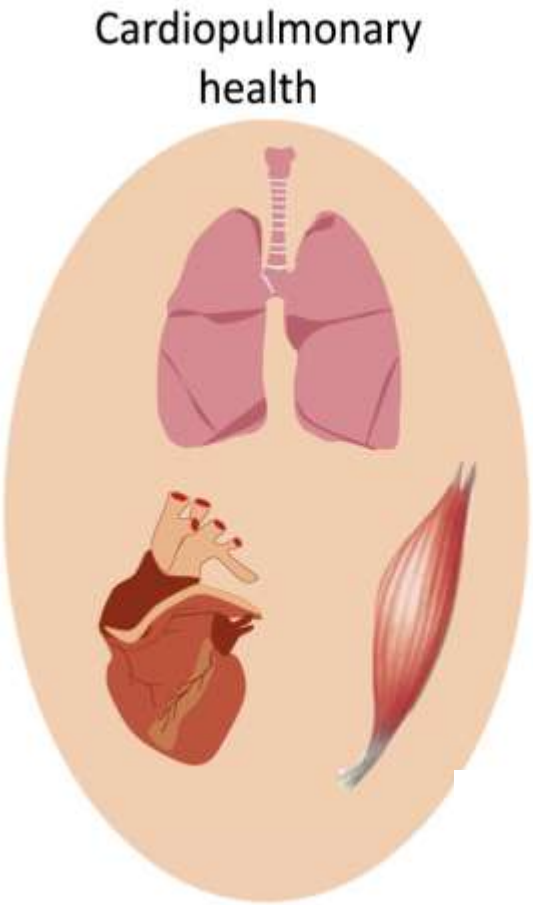


Cardiopulmonary Exercise Test might be Helpful For Insight Interpretation of Impaired Pulmonary Function on Recovered COVID-19 Patients

Eur Resp J 2021

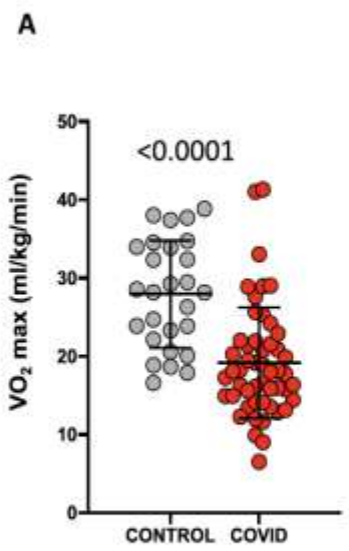
Yi Gao, Ruchong Chen, Qian Geng, Xiaoneng Mo, Chen Zhan, Wenhua Jian, Shiyue Li, Jinping Zheng

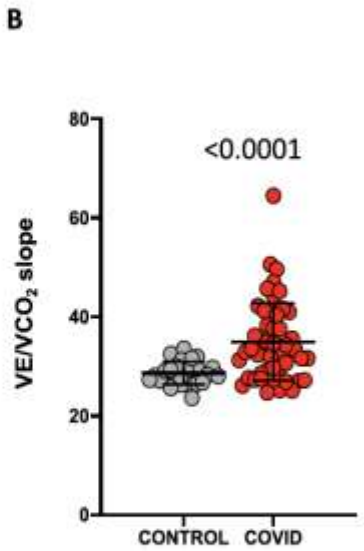
Ce que dit la littérature



VO_2 plus faible

HV plus marquée





Ce que dit la Pratique…

Age	39	**VEMS**	3,35	**VEMS/CVF**	93%
Poids	120	**CVF**	3,60	**VEMS/CVL**	84%
Taille	1,87	**CVL**	4,01	**DLCO**	
PB (mmHg)	750	**Cap. Inspiratoire**	3,18	**V. Capillaire**	0

		Stable	Interméd.	Max	Max Attendues
Puissance Mécanique	*watts*	**30**	**60**	**120**	**1,00**
Dyspnée	*Borg*	**0**	**4**	**7**	**Watt/Kg**
Fatigue	*Borg*	**3**	**7**	**10**	
Réponse Métabolique					
VO_2	$lO_2.min^{-1}$	0,97	1,41	1,89	3,668
VO_2	$mlO_2.min^{-1}.kg$	8,1	11,8	15,8	30,6
RER		0,98	0,81	**0,9**	52%
pH		7,5	7,45	7,42	7,49
Lactatémie	$mmol.L^{-1}$	1,79	3,36	4,57	5,24
Réponse Ventilatoire					
VE	$L.min^{-1}$	65	68	91	134
VE/VO_2		67	48	48	
VE/VCO_2		68	60	53	
RV	*%*	51%	49%	32%	
VT	*ml*	1204	1115	1596	
VT/CV_{MAX}		33%	31%	44%	60-70
FR	*cpm*	**54**	**61**	**57**	
Echanges Gazeux		*120*	*110*	*114*	**Récup + 4'**
$PAiO_2$	*mmHg*	*120*	*110*	*114*	**129**
PaO2	*mmHg*	**103**	**95**	**88**	**104**
$P(Ai-a)O_2$	*mmHg*	17	15	26	**25**
SaO_2	*%*	98,0	97,0	96,9	**98**
$PaCO_2$	*mmHg*	26	30	29	**20**
VD/VT	*%*	43	40	34	**36**
Réponse Cardio-Circulatoire	***Qc estimé***	***10,34***	***12,76***	***15,40***	
PAS/PAD	*mmHg*	120/80		150/80	184,65
FC	*bpm*	118	126	145	185
VO_2/FC	$mlO_2.FC^{-1}$	8,2	11,2	13,0	19,9
			Valeurs calculées		
$\Delta VO_2/Watt$	$mlO_2.watt^{-1}$		10,2		10,2 ± 2
$\Delta FC/\Delta VO_2$	$batt.L.O_2^{-1}$		29		< 50

Age	39	**VEMS**	3,35	**VEMS/CVF**	93%
Poids	120	**CVF**	3,60	**VEMS/CVL**	84%
Taille	1,87	**CVL**	4,01	**DLCO**	
PB (mmHg)	750	**Cap. Inspiratoire**	3,18	**V. Capillaire**	0

		Stable	Interméd.	Max	Max Attendues
Puissance Mécanique	*watts*	**30**	**60**	**120**	**1,00**
Dyspnée	*Borg*	**0**	**4**	**7**	**Watt/Kg**
Fatigue	*Borg*	**3**	**7**	**10**	
Réponse Métabolique					
VO_2	$l O_2 . min^{-1}$	0,97	1,41	1,89	3,668
VO_2	$ml O_2 . min^{-1} . kg$	8,1	11,8	15,8	30,6
RER		0,98	0,81	**0,9**	52%
pH		7,5	7,45	7,42	7,49
Lactatémie	$mmol.L^{-1}$	1,79	3,36	4,57	5,24
Réponse Ventilatoire					
VE	$L.min^{-1}$	65	68	91	134
VE/VO_2		67	48	48	
VE/VCO_2		68	60	53	
RV	*%*	51%	49%	32%	
VT	*ml*	1204	1115	1596	
VT/CV_{MAX}		33%	31%	44%	60-70
FR	*cpm*	**54**	**61**	**57**	
Echanges Gazeux		*120*	*110*	*114*	**Récup + 4'**
$PAiO_2$	*mmHg*	*120*	*110*	*114*	**129**
PaO2	*mmHg*	**103**	**95**	**88**	**104**
$P(Ai-a)O_2$	*mmHg*	17	15	26	**25**
SaO_2	*%*	98,0	97,0	96,9	**98**
$PaCO_2$	*mmHg*	26	30	29	**20**
VD/VT	*%*	43	40	34	**36**
Réponse Cardio-Circulatoire	***Qc estimé***	***10,34***	***12,76***	***15,40***	
PAS/PAD	*mmHg*	120/80		150/80	184,65
FC	*bpm*	118	126	145	185
VO_2/FC	$ml O_2 . FC^{-1}$	8,2	11,2	13,0	19,9
			Valeurs calculées		
$\Delta VO_2/Watt$	$ml O_2 . watt^{-1}$		10,2		10,2 ± 2
$\Delta FC/\Delta VO_2$	$batt . L.O_2^{-1}$		29		< 50

Scores BORG très élevés

VO_2 adapté à la puissance mécanique

PMA très diminuée limitée par les symptômes

Lactatémie attendue pour la puissance

HV_E très franche + HV chronique car RER_{MAX} = 0.9

Réserve Ventilatoire présente

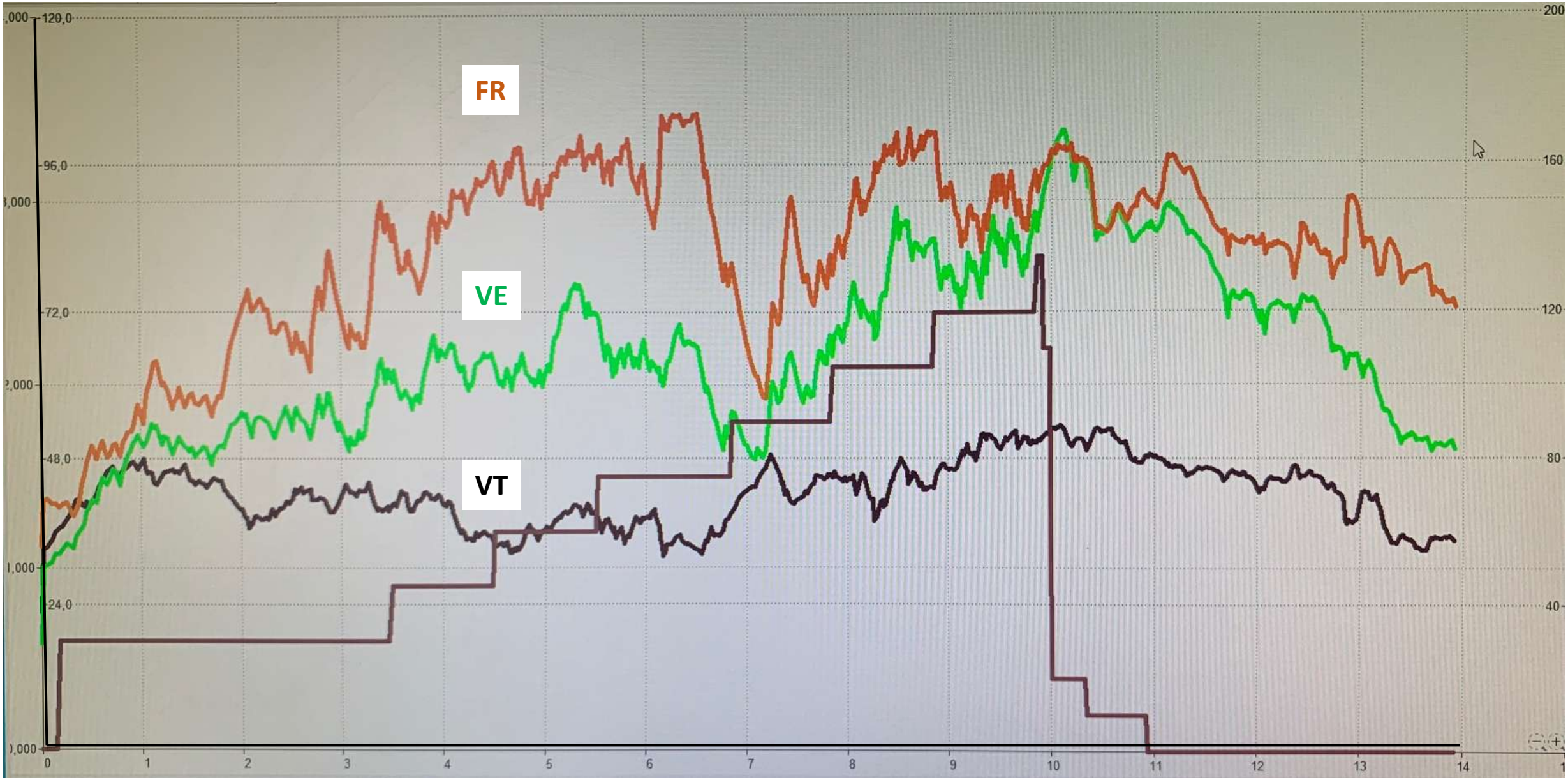
Tachypnée précoce

Echanges gazeux NORMAUX

FC_{MAX} non atteinte (78 % FMT)

Pente VO_2/W normale

120,0
190
170
96,0
150
72,0
130
110
90
24,0
70
50
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14
VE
FC
VO2


FR
VE
VT
120,0
96,0
72,0
48,0
24,0
200
160
120
80
40
0
1
2
3
4
5
6
7
8
9
10
11
12
13
14

CHAOTIC BREATHING IN POST COVID-19 BREATHLESSNESS: A KEY FEATURE CHARACTERISED BY APPROXIMATE ENTROPY

Abstract Thorax 2021

Approximate entropy (ApEn) of ventilatory variables during incremental exercise			
ApEn Tidal Volume	1.61 (0.05)	1.28 (0.23)	1.02 (0.29)
ApEn Breathing Frequency	1.40 (0.10)	1.41 (0.20)	1.32 (0.21)
ApEn Minute Ventilation	1.22 (0.11)	0.97 (0.30)	0.65 (0.23)
	COVID +	Breathing Disorder	Healthy

Age	66	**VEMS**	2,61	**VEMS/CVF**	79%
Poids	68	**CVF**	3,31	**VEMS/CVL**	76%
Taille	1,62	**CVL**	3,42	**DLCO**	25
PB (mmHg)	750	**Cap. Inspiratoire**	2,87	**V. Capillaire**	75

		Stable	Interméd.	Max	Max Attendues
Puissance Mécanique	*watts*	**30**	**105**	**120**	**1,76**
Dyspnée	*Borg*	1	3	7	**Watt/Kg**
Fatigue	*Borg*	1	3	7	Douleur 7
Réponse Métabolique					
VO_2	$lO_2.min^{-1}$	0,67	1,38	1,71	1,722
VO_2	$mlO_2.min^{-1}.kg$	9,9	20,3	25,1	25,3
RER		0,75	0,94	1,04	99%
pH		7,37	7,349	7,346	
Lactatémie	$mmol.L^{-1}$	2,3	5,15	7,54	
Réponse Ventilatoire					
VE	$L.min^{-1}$	21	61	93	104
VE/VO_2		31	44	54	
VE/VCO_2		42	47	52	
RV	%	80%	42%	11%	
VT	*ml*	840	1488	1661	
VT/CV_{MAX}		25%	45%	50%	60-70
FR	*cpm*	25	41	56	
Echanges Gazeux		*98*	*109*	*121*	
$PAiO_2$	*mmHg*	*98*	*109*	*121*	
PaO2	*mmHg*	74	85	91	
$P(Ai-a)O_2$	*mmHg*	24	25	30	29
SaO_2	%	95,0	96,0	96,7	
$PaCO_2$	*mmHg*	37	35	27	
VD/VT	%	34	40	46	26
Réponse Cardio-Circulatoire	***Qc estimé***	***8,69***	***12,59***	***14,41***	
	T.T cap Mean	***0,52***	***0,36***	***0,31***	
PAS/PAD	*mmHg*	160/80		220/100	93%
FC	*bpm*	101	134	156	167
VO_2/FC	$mlO_2.FC^{-1}$	6,6	10,3	11,0	10,3
			Valeurs calculées		
$\Delta VO_2/Watt$	$mlO_2.watt^{-1}$		11,6		10,2 ± 2
$\Delta FC/\Delta VO_2$	$batt.L.O_2^{-1}$		53		< 50

Dyspnée depuis Covid avril 20Z0
TJ DOULEURS MUSCULAIRES AVEC CRAMPES
A perdu (et repris 6 kg) pd COVID

O_2 pd 2 semaines Douleurs muscul._Courbatures_ Céphalées _ Agueusie Anosmie-
SpO_2 : 87 %
Pas EP (TDM -)
TTT : ATB ET PAS CORTISONE

AP : MARCHE 1 h / jour
Ex fumeur 1pq /j pd 40 ans Stop il ya 10 ans
TTT: Candesartan_Metformine_Kardegic_Glicazide_Tahor

Age	66	**VEMS**	2,61	**VEMS/CVF**	79%
Poids	68	**CVF**	3,31	**VEMS/CVL**	76%
Taille	1,62	**CVL**	3,42	**DLCO**	25
PB (mmHg)	750	**Cap. Inspiratoire**	2,87	**V. Capillaire**	75

		Stable	Interméd.	Max	Max Attendues
Puissance Mécanique	*watts*	**30**	**105**	**120**	**1,76**
Dyspnée	*Borg*	1	3	8	**Watt/Kg**
Fatigue	*Borg*	1	3	5	**Douleur 8**
Réponse Métabolique					
VO_2	$lO_2.min^{-1}$	0,67	1,38	1,71	1,722
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$PAiO_2$	*mmHg*	*98*	*109*	*121*	
PaO2	*mmHg*	74	85	91	
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VO_2/FC	$mlO_2.FC^{-1}$	6,6	10,3	11,0	10,3
			Valeurs calculées		
$\Delta VO_2/Watt$	$mlO_2.watt^{-1}$		11,6		10,2 ± 2
$\Delta FC/\Delta VO_2$	$batt.L.O_2^{-1}$		53		< 50

VO_2 limitée par **DOULEUR** +++ et DYSPNEE

VO_2 adaptée à la puissance mécanique

Hyperventilation ++ avec réserve ventilatoire épuisée

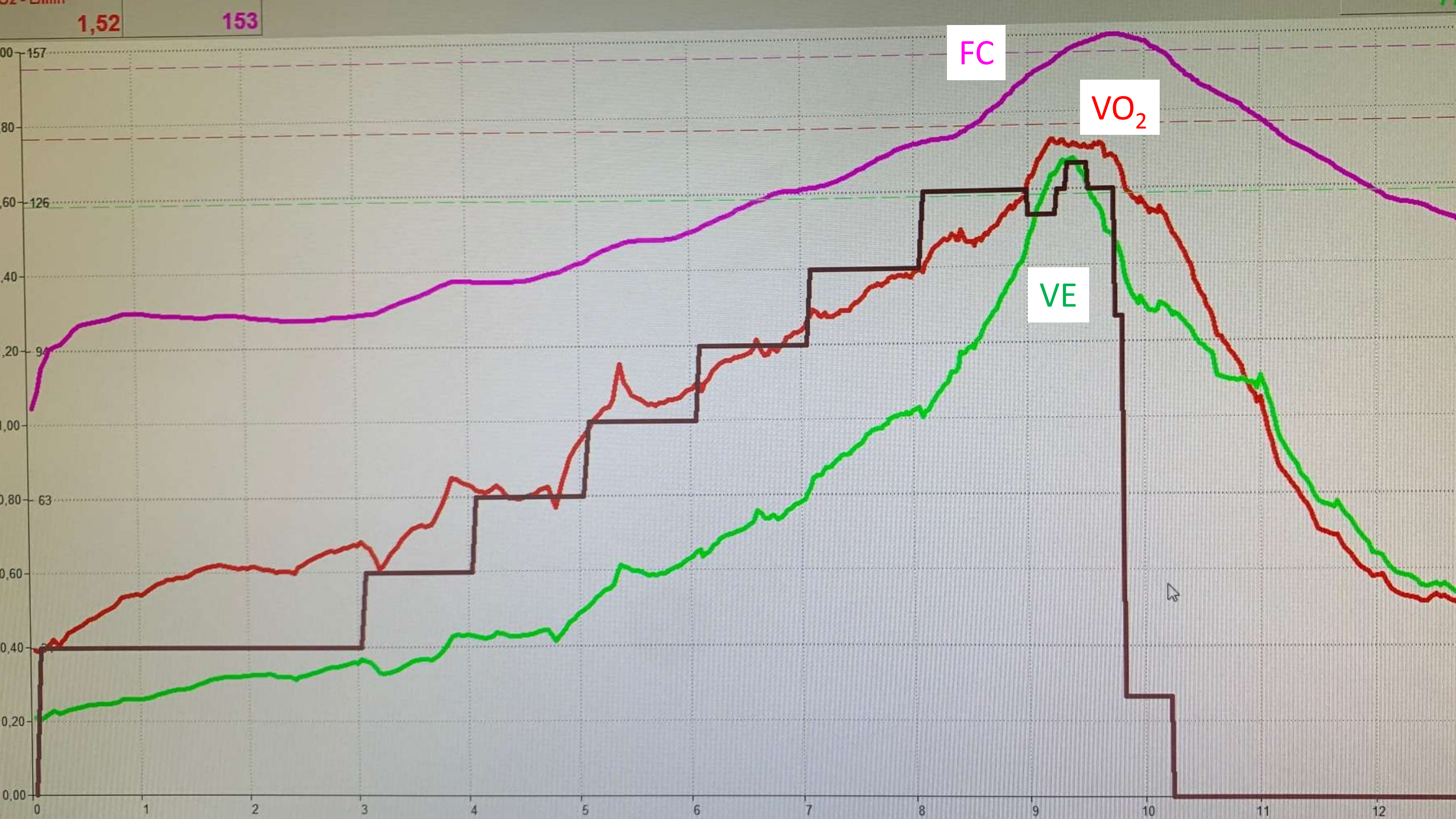
Tachypnée ++

Echanges Gazeux normaux

VD/VT haut mais tachypnée

FC quasi Maximale

Pente VO_2/W normale


1,52
153
FC
VO2
VE
157
126
94
63
0,00
0,20
0,40
0,60
0,80
1,00
1,20
1,40
1,60
1,80
2,00
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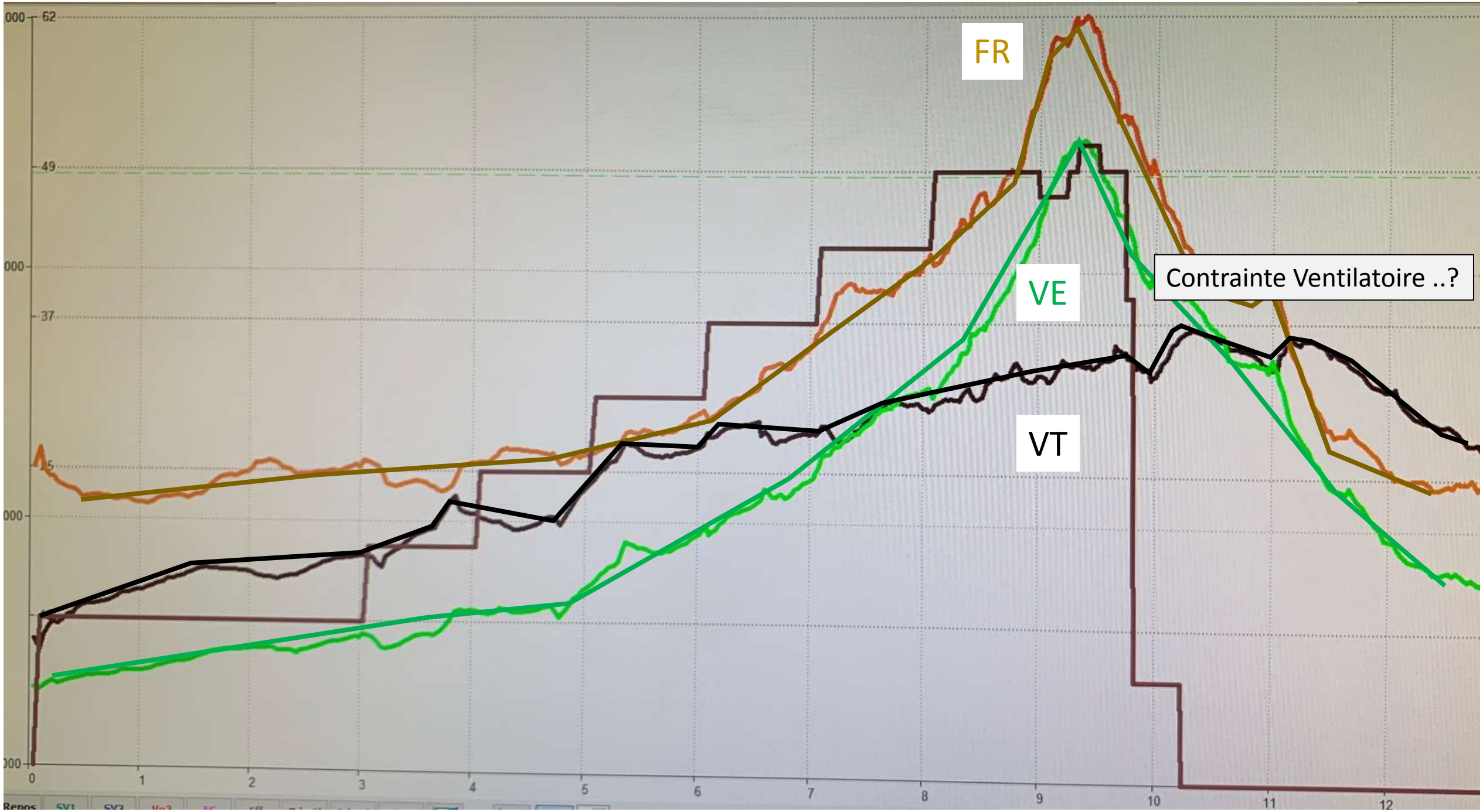
FR
VE
VT
Contrainte Ventilatoire ..?
62
49
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12

DOI: 10.1113/EP088460

Experimental Physiology WILEY

EXCHANGE OF VIEWS

The role of muscle mechano and metaboreflexes in the control of ventilation: breathless with (over) excitement?

Michael White[1] | Richard Bruce[2]

Phénotype fonctionnels ?

A. Dyspnée prédominante
   - Sans limitation ventilatoire surtout chez sujets
   - Perception surexprimée

B. L'HV est fréquente mais le + souvent d'ampleur non limitante

C. Myalgie/Incompétence musculaire prédominante (± Dyspnée)

D. Dysrythmie Ventilatoire : *Phénotype (s) de Chaos ventilatoire*

E. *Chaos ventilatoire* associée à Dysautonomie Cardio-circulatoire

F. Dysautonomie Cardio-circulatoire isolée

G. Interférence HV/ Dysrythmie et Souffrance musculaire ?

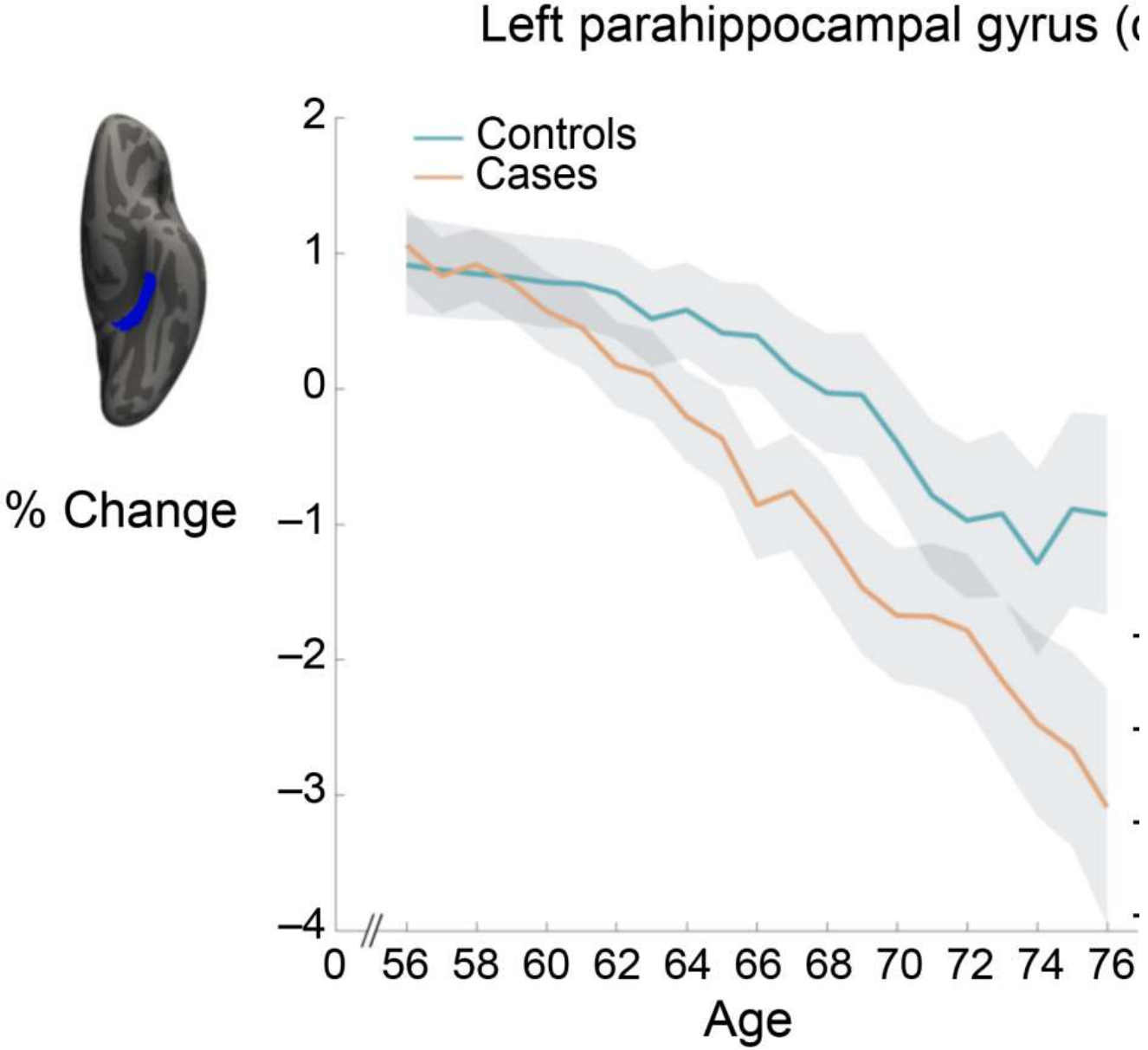
nature

https://doi.org/10.1038/s41586-022-04569-5

Accelerated Article Preview

2022

SARS-CoV-2 is associated with changes in brain structure in UK Biobank



The high mental health burden of “Long COVID” and its association with on-going physical and respiratory symptoms in all adults discharged from hospital

Adults discharged from hospital with COVID-19 may experience “Long COVID”, where mental health symptoms are significant and linked to

physical symptoms such as breathlessness.

Clinicians should use brief screening questionnaires to support their recovery.

nature 2022

https://doi.org/10.1038/s41586-022-04569-5

Accelerated Article Preview

SARS-CoV-2 is associated with changes in brain structure in UK Biobank

Received: 19 August 2021

Accepted: 21 February 2022

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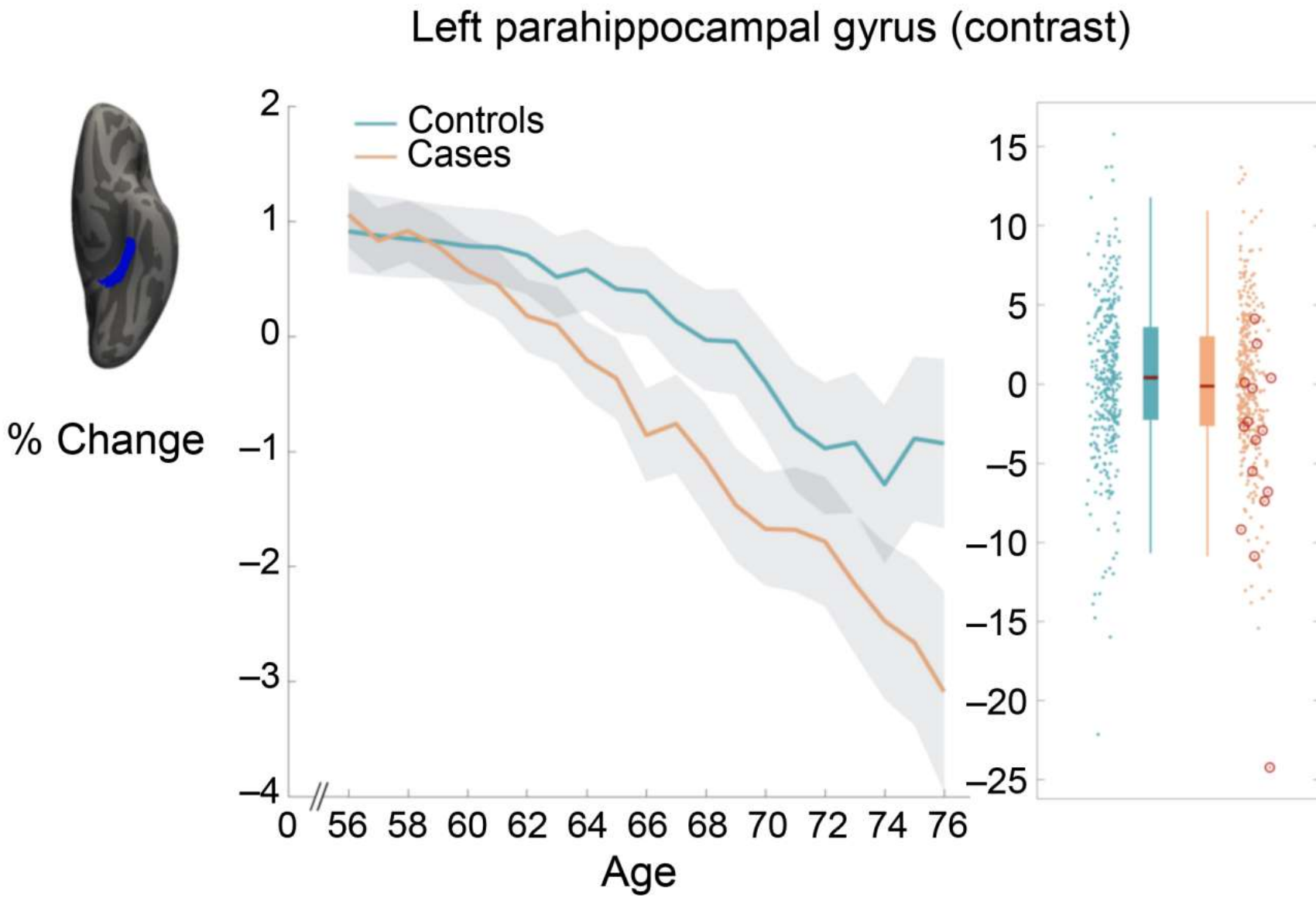
Published online: 07 March 2022

Gwenaëlle Douaud, Soojin Lee, Fidel Alfaro-Almagro, Christoph Arthofer, Chaoyue Wang, Paul McCarthy, Frederik Lange, Jesper L. R. Andersson, Ludovica Griffanti, Eugene Duff, Saad Jbabdi, Bernd Taschler, Peter Keating, Anderson M. Winkler, Rory Collins, Paul M. Matthews, Naomi Allen, Karla L. Miller, Thomas E. Nichols & Stephen M. Smith

PREVIEW


Left parahippocampal gyrus (contrast)
% Change
Controls
Cases
2
1
0
−1
−2
−3
−4
0
56
58
60
62
64
66
68
70
72
74
76
Age
15
10
5
0
−5
−10
−15
−20
−25

Open Forum Infectious Diseases
REVIEW ARTICLE

Postacute COVID-19: An Overview and Approach to Classification

Eva M. Amenta,[1] Amy Spallone,[2,0] Maria C. Rodriguez-Barradas,[2,3] Hana M. El Sahly,[2,4] Robert L. Atmar,[2] and Prathit A. Kulkarni[2,3]

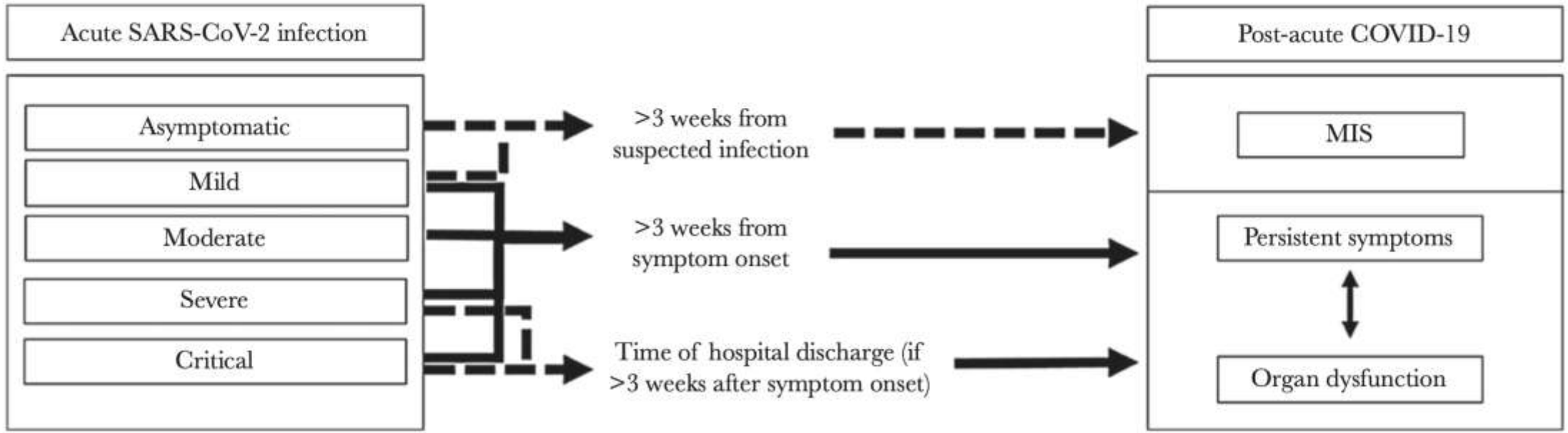


Figure 1. Progression of acute SARS-CoV-2 infection to postacute COVID-19. The figure shows the various forms of progression fo acute SARS-CoV-2 infection (classified using NIH symptom severity criteria [1]) to the proposed categories of postacute COVID-19, which include (1) persistent symptoms; (2) organ dysfunction; and (3) MIS. There is likely a relationship between organ dysfunction and persistent symptoms that is not yet completely understood. Abbreviations: COVID-19, coronavirus disease 2019; MIS, multisystem inflammatory syndrome; NIH, National Institutes of Health; SARS-CoV-2, severe acute respiratory syndrome coronavirus 2.