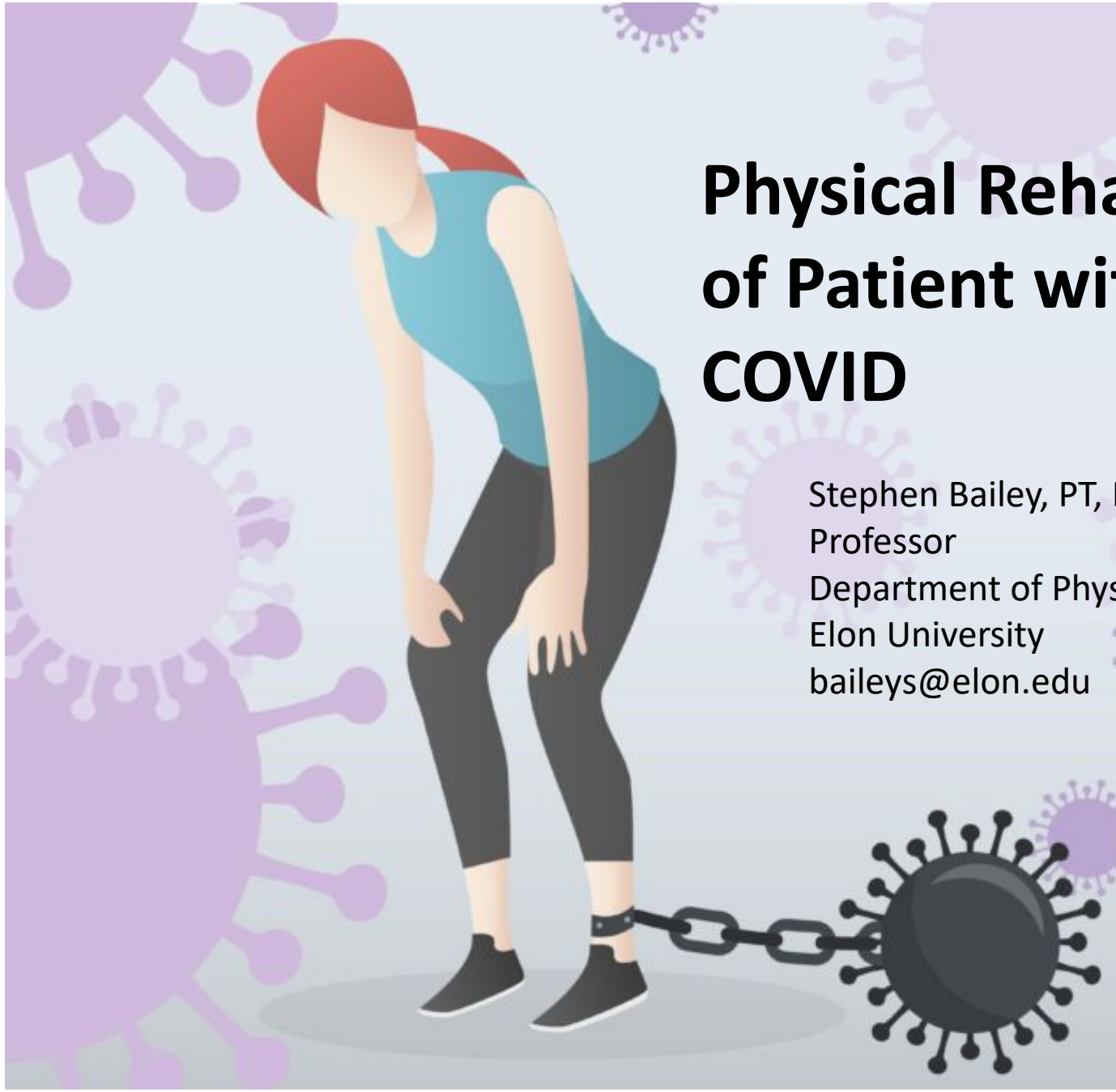

Physical Rehabilitation of Patient with Long COVID

Stephen Bailey, PT, PhD, FACSM
Professor
Department of Physical Therapy Education
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PCNA
PREVENTIVE CARDIOVASCULAR NURSES ASSOCIATION

NCCRA | North Carolina Cardiopulmonary Rehabilitation Association

Learning Objectives

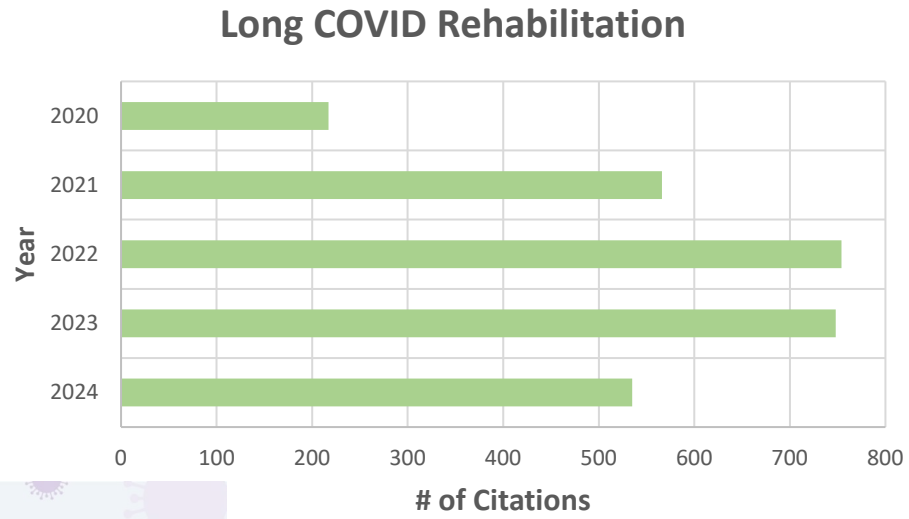
- Learning Objectives:
- 1. Appreciate the scientific/medical definition of Long COVID
- 2. Be familiar with the known frequency of occurrence of Long COVID
- 3. Understand the wide-ranging clinical presentations of people experiencing Long COVID
- 4. Appreciate the impact of Long COVID on physical performance/functional abilities.
- 5. Recognize the value of physical rehabilitation on improving physical performance and functional ability in people with Long COVID
- 6. Understand the appropriate strategies that should be used to adapt exercise prescription to serve people with Long COVID

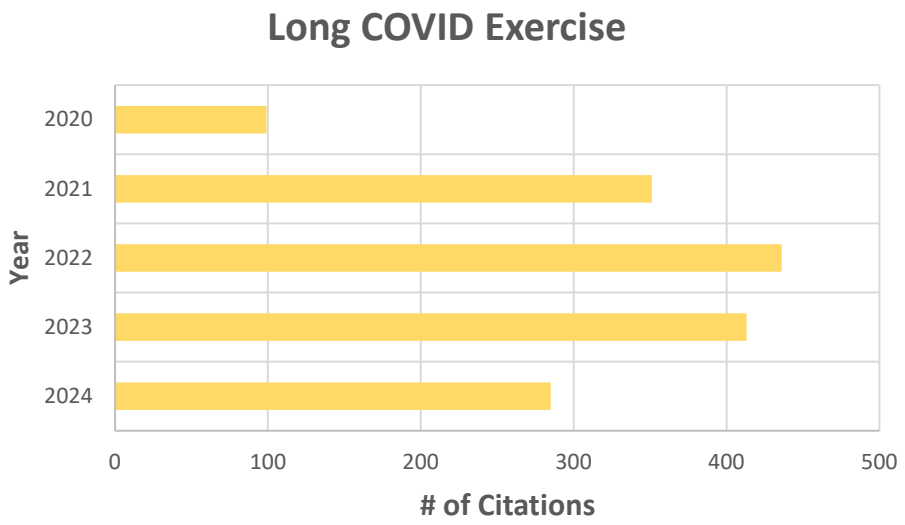
Big Picture Objectives

1. Set some boundaries
2. Identify the impact
3. Explore possible mechanism
4. How can we help?

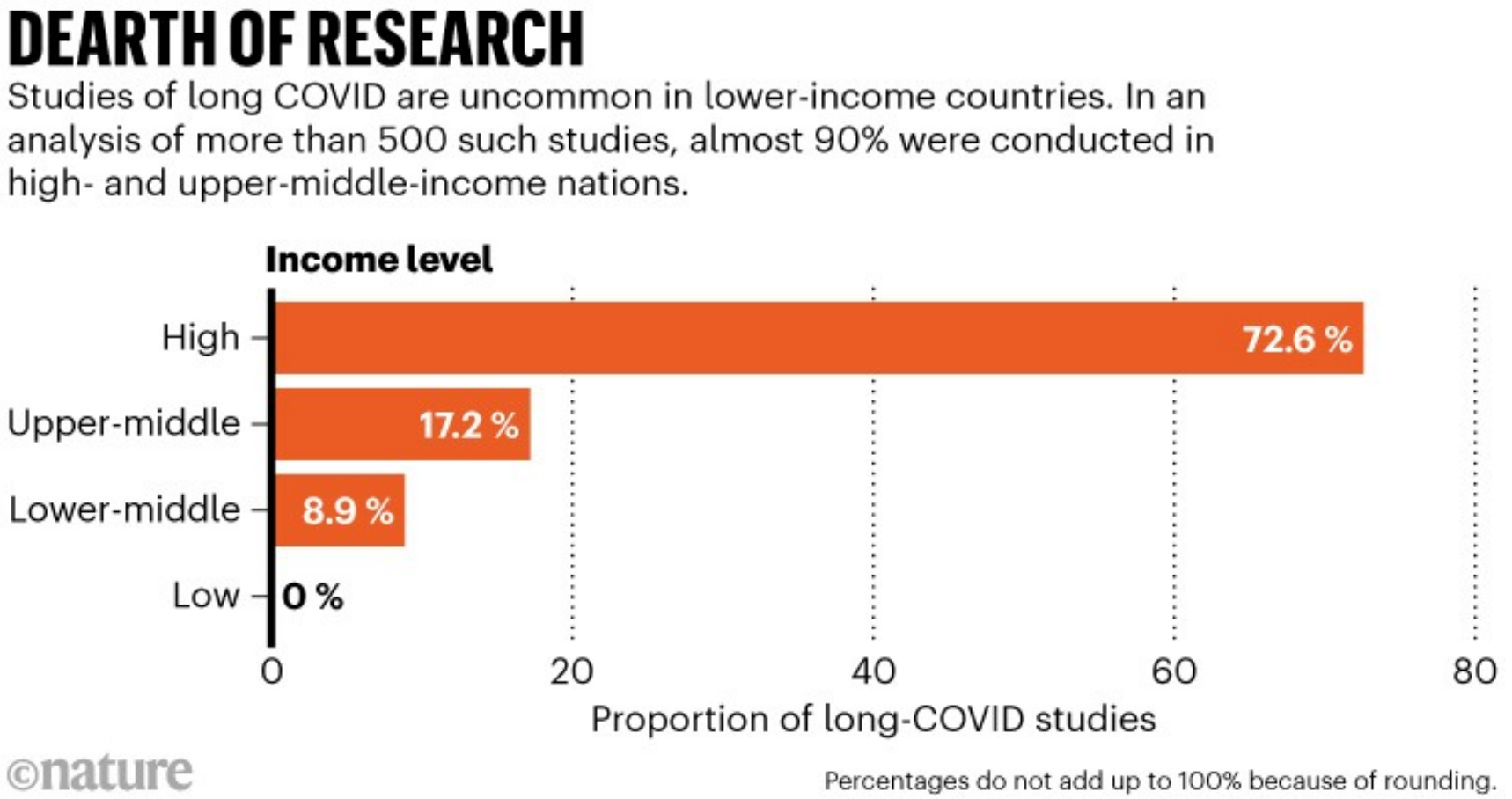

Sources of Information
1. Literature
2. Professional Resources
3. Professional Media
4. Clinical Experience

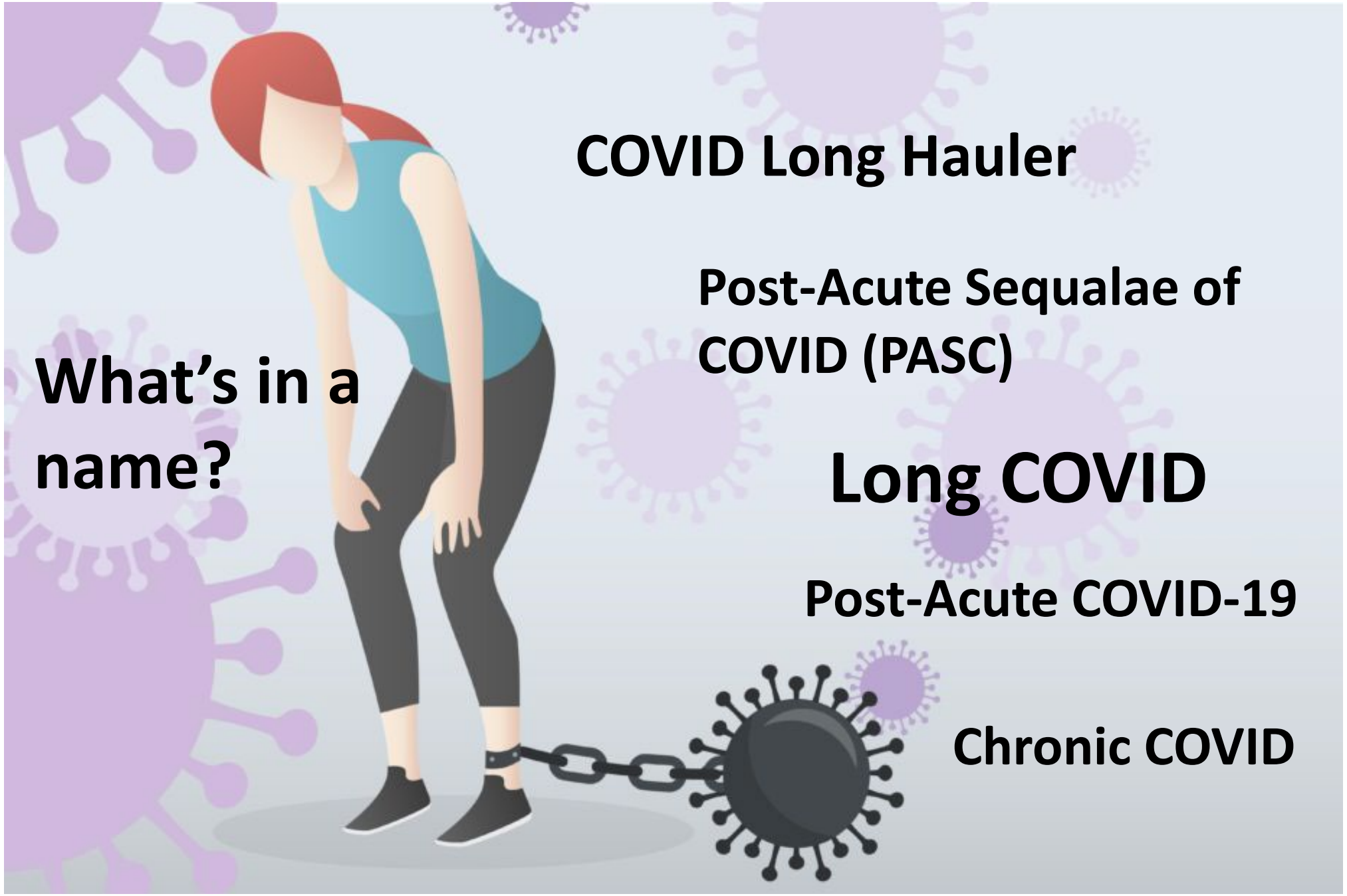
Long COVID on PubMed





Long COVID is a Double Curse in Low-Income Nations




What's in a name?
COVID Long Hauler
Post-Acute Sequalae of COVID (PASC)
Long COVID
Post-Acute COVID-19
Chronic COVID

How and why patients made Long Covid

Felicity Callard [a,*], Elisa Perego [b]

[a] University of Glasgow School of Geographical and Earth Sciences, University of Glasgow, United Kingdom
[b] University College London Institute of Archaeology, UCL, United Kingdom

Social Science & Medicine 268 (2021) 113426

LONG COVID

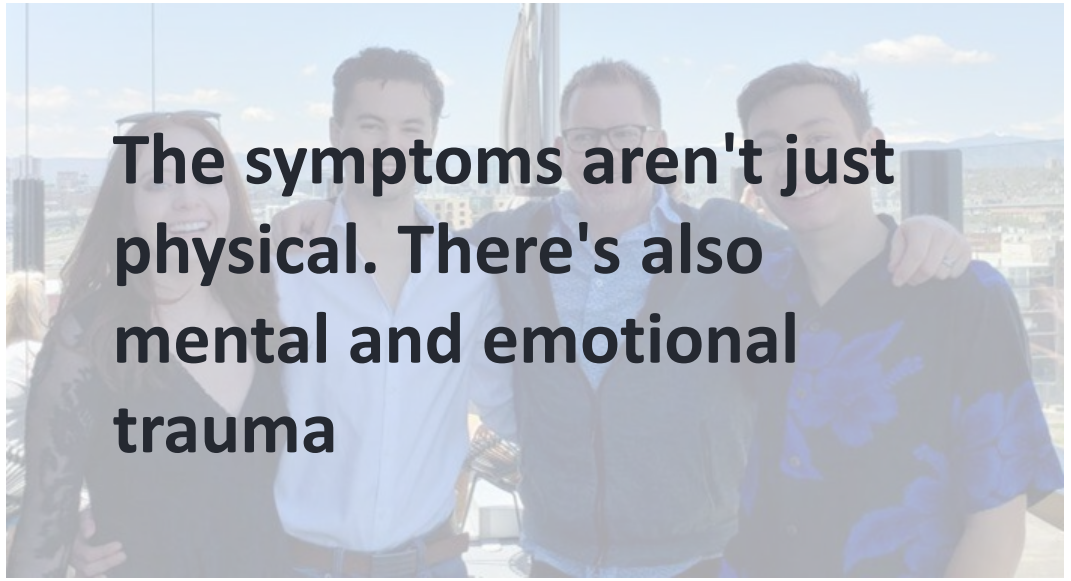
- **Driven by population and not the medical community**
- **Challenges Time Course**
- **Challenges theories around impact of initial severity**
- **Provides for large umbrella**
- **Reflects the lived experience**

Current Landscape of Long COVID

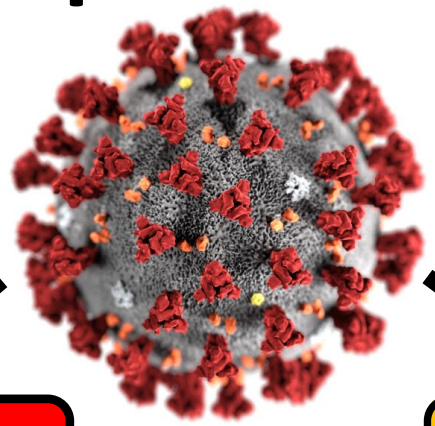
https://www.cpr.org/2021/02/25/one-year-later-doctors-are-still-trying-to-understand-covids-long-term-physical-and-emotional-effects/

Ty Goodwin

- Felt like he has COVID-19, shortness of breath, malaise, fevers, headaches and fatigue — for the last year.
- “I was a marathon runner and a triathlete before this,” he said. “I've had nights where I wake up out of breath.”
- “After 60 some doctors appointments, they eliminated all pre-2020 kind of traditional medical diagnoses, meaning they couldn't explain why I was running out of breath,”



All of the possible outcomes?



Asymptomatic

Hospitalized

Non-Hospitalized

Consequences of Extreme Deconditioning or Still Recovering

Prolonged Symptoms

Additive Diagnosis

Long COVID

Delayed Impact

Post-acute COVID-19 syndrome

Ani Nalbandian[1,24], Kartik Sehgal[2,3,4,24] ✉, Aakriti Gupta[1,5,6], Mahesh V. Madhavan[1,5], Claire McGroder[7], Jacob S. Stevens[8], Joshua R. Cook[9], Anna S. Nordvig[10], Daniel Shalev[11], Tejasav S. Sehrawat[12], Neha Ahluwalia[13], Behnood Bikdeli[4,5,6,14], Donald Dietz[15], Caroline Der-Nigoghossian[16], Nadia Liyanage-Don[17], Gregg F. Rosner[1], Elana J. Bernstein[18], Sumit Mohan[8], Akinpelumi A. Beckley[19], David S. Seres[20], Toni K. Choueiri[2,3,4], Nir Uriel[1], John C. Ausiello[9], Domenico Accili[9], Daniel E. Freedberg[21], Matthew Baldwin[7], Allan Schwartz[1], Daniel Brodie[7], Christine Kim Garcia[7], Mitchell S. V. Elkind[10,22], Jean M. Connors[4,23], John P. Bilezikian[9], Donald W. Landry[8] and Elaine Y. Wan[1] ✉

NATURE MEDICINE | VOL 27 | APRIL 2021 | 601–615 | www.nature.com/naturemedicine

4 weeks or 12 weeks

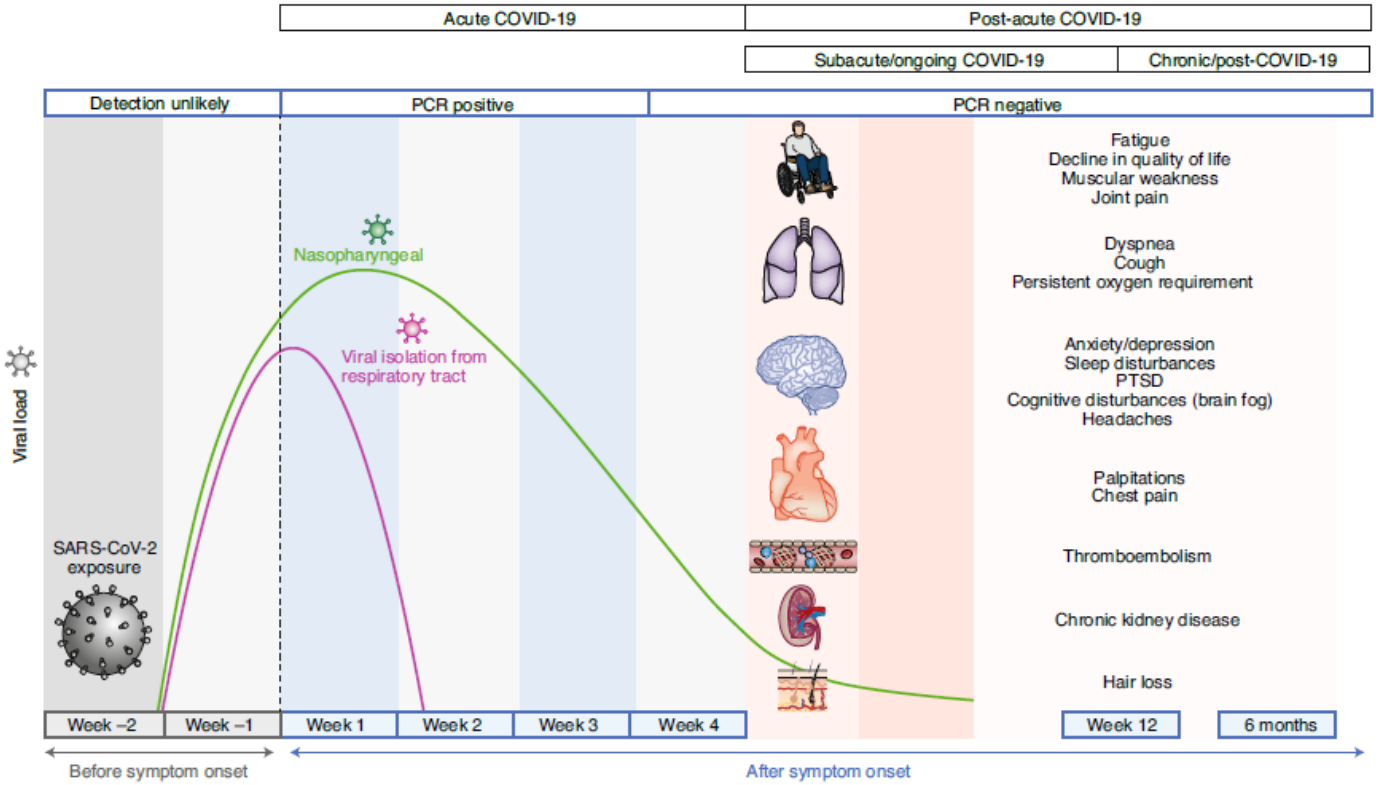
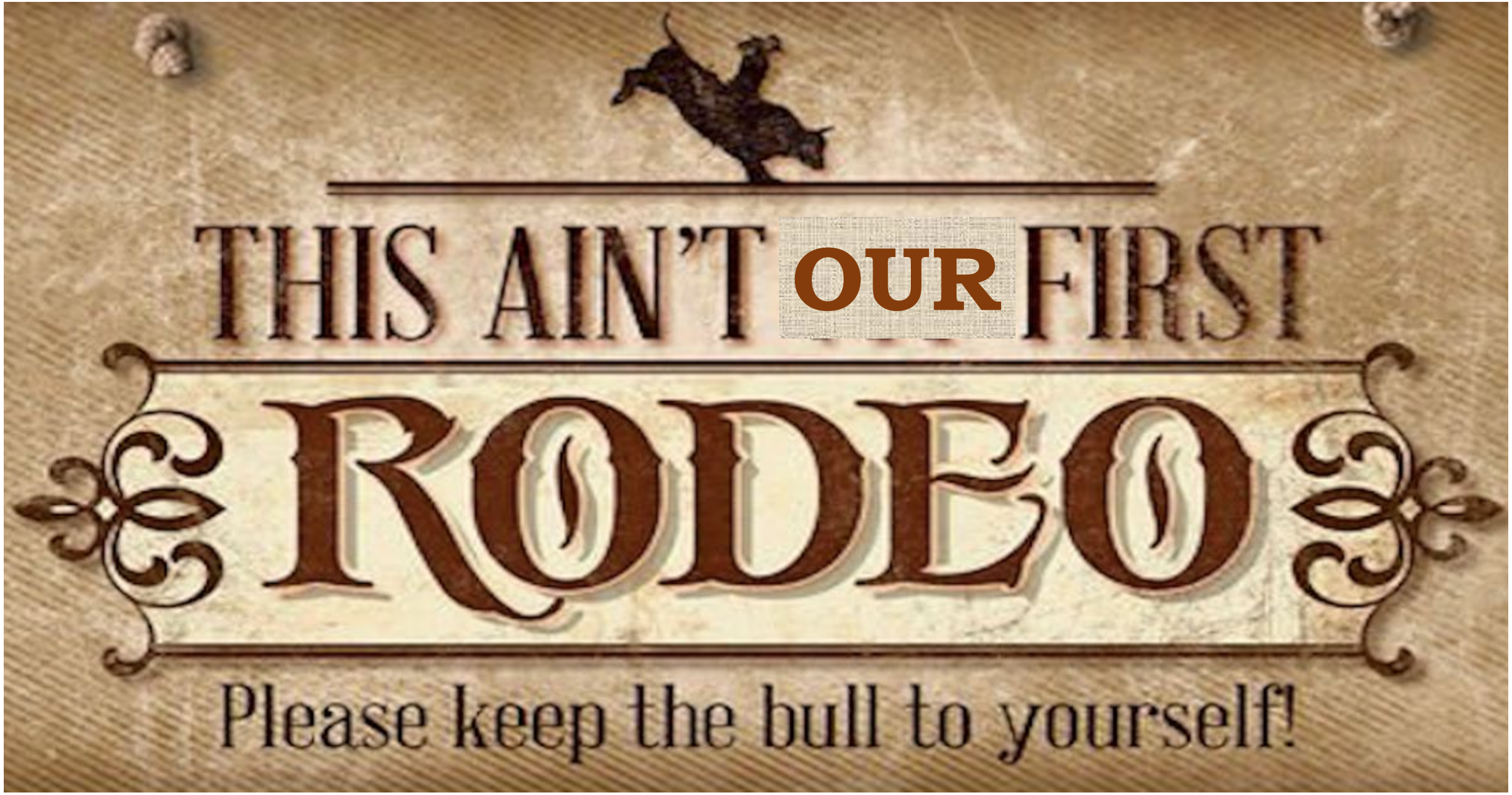


Fig. 1 | Timeline of post-acute COVID-19. Acute COVID-19 usually lasts until 4 weeks from the onset of symptoms, beyond which replication-competent SARS-CoV-2 has not been isolated. Post-acute COVID-19 is defined as persistent symptoms and/or delayed or long-term complications beyond 4 weeks from the onset of symptoms. The common symptoms observed in post-acute COVID-19 are summarized.


THIS AIN'T OUR FIRST
RODEO
Please keep the bull to yourself!

Post-Zika syndrome

n.neurology.org/content/zika-virus-associated-guillain-...

Neurology®

Zika virus-associated Guillain-Barré syndrome: Post-infectious or para-infectious complication?

- Patrick Gerardin, Clinician Researcher, INSERM CIC 1410, CHU de La Reunion, Saint Pierre, Reunion, France; UMR 134 PIMIT, Universite de La R
- V.M Cao-Lormeau, P. Tournebize, T. Cerny

Submitted January 24, 2017

Siu et al. reported the concurrent onset of polyradiculoneuritis and acute Zika virus (ZIKV) infection, while the virus was not cleared from the serum. [1] Guillain-Barre syndrome (GBS) is usually described as a post-infectious disease during which progressive flaccid paralysis develops after a phase of latency following infection. In the most common pathogenetic framework, this free interval permits the generation of sufficient levels of antibodies that crossreact by molecular mimicry with specific components of peripheral nerves, causing myelin or axonal injury, as previously documented with ZIKV

Post-SARS syndrome

Moldofsky and Patcai *BMC Neurology* 2011, **11**:37
http://www.biomedcentral.com/1471-2377/11/37

BMC Neurology

RESEARCH ARTICLE Open Access

Chronic widespread musculoskeletal pain, fatigue, depression and disordered sleep in chronic post-SARS syndrome; a case-controlled study

Harvey Moldofsky[1*], John Patcai[2,3]

Post-MERS syndrome

Data synthesis: Of 1,169 identified studies, 28 were included in the analysis. Pooled analysis revealed that common complications up to 6 months after discharge were: impaired diffusing capacity for carbon monoxide (prevalence 27%, 95% confidence interval (CI) 15–45%); and reduced exercise capacity (mean 6-min walking distance 461 m, CI 450–473 m). The prevalences of post-traumatic stress disorder (39%, 95% CI 31–47%), depression (33%, 95% CI 20–50%) and anxiety (30%, 95% CI 10–61) beyond 6 months after discharge were considerable. Low scores on Short-Form 36 were identified beyond 6 months after discharge.

LONG-TERM CLINICAL OUTCOMES IN SURVIVORS OF SEVERE ACUTE RESPIRATORY SYNDROME (SARS) AND MIDDLE EAST RESPIRATORY SYNDROME (MERS) CORONAVIRUS OUTBREAKS AFTER HOSPITALISATION OR ICU ADMISSION: A SYSTEMATIC REVIEW AND META-ANALYSIS

Hassaan AHMED, MRes[1]*, Kajal PATEL[1]*, Darren C. GREENWOOD, PhD[2], Stephen HALPIN, MRCP[3,7], Penny LEWTHWAITE, PhD, FRCP[4], Abayomi SALAWU, MBBS, FRCSI[5], Lorna EYRE, FFICM[6], Andrew BREEN, FFICM[6], Rory O'CONNOR, MD, FRCP[3,7], Anthony JONES, MD, FRCP[7], Manoj SIVAN, MD, FRCPEd[3,7]

From the [1]School of Medicine, University of Manchester, Manchester, [2]School of Medicine and Leeds Institute for Data Analytics, University of Leeds, [3]Academic Department of Rehabilitation Medicine, University of Leeds and National Demonstration Centre of Rehabilitation Medicine, Leeds Teaching Hospitals NHS trust, [4]Department of Infectious Diseases, Leeds Teaching Hospitals NHS Trust, Leeds, [5]Department of Rehabilitation Medicine, Hull University Teaching Hospitals NHS Trust, Hull, [6]Intensive Care Unit, Leeds Teaching Hospitals NHS Trust, Leeds, UK and [7]Division of Neuroscience and Experimental Psychology, University of Manchester, Manchester, UK

Joint first authors

Journal of REHABILITATION MEDICINE

Post-Ebola syndrome

wwwnc.cdc.gov/eid/article/22/4/15-1302_article

CDC Centers for Disease Control and Prevention
CDC 24/7: Saving Lives, Protecting People™

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EID Journal > Volume 22 > Number 4—Apr

Volume 22, Number 4—April 2016

Research

Post-Ebola Syndrome, Si

Janet T. Scott, Foday R. Sesay, Thomas
Author affiliations: University of Liverpo
Research Unit in Emerging and Zoonoti
Military Hospital, Freetown, Sierra Leon

Abstract

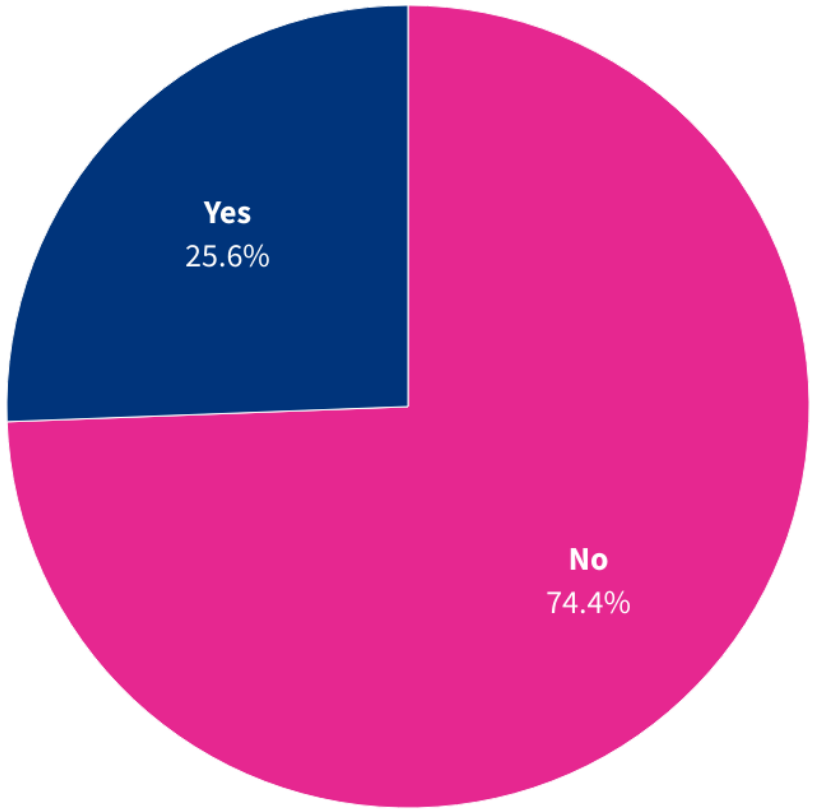
Thousands of persons have survived Ebola virus disease. Almost all survivors describe symptoms that persist or develop after hospital discharge. A cross-sectional survey of the symptoms of all survivors from the Ebola treatment unit (ETU) at 34th Regimental Military Hospital, Freetown, Sierra Leone (MH34), was conducted after discharge at their initial follow-up appointment within 3 weeks after their second negative PCR result. From its opening on December 1, 2014, through March 31, 2015, the MH34 ETU treated 84 persons (8–70 years of age) with PCR-confirmed Ebola virus disease, of whom 44 survived. Survivors reported musculoskeletal pain (70%), headache (48%), and ocular problems (14%). Those who reported headache had had lower admission cycle threshold Ebola PCR than did those who did not ($p<0.03$). This complete survivor cohort from 1 ETU enables analysis of the proportion of symptoms of post-Ebola syndrome. The Ebola epidemic is waning, but the effects of the disease will remain.

So how many people are we talking about?

Sort of kind of official numbers (at this moment)	472,253,085 cases documented in the world (so far)
• 25% have symptoms for at least a month • 1 in 10 remain unwell after 12-weeks (or 6 months)	• So around 47 million people worldwide may be defined as having Long COVID • 7.9 Million in the US

25.6% of adults who have had COVID-19 report having experienced long COVID.

Percentage of adults who have ever experienced long COVID, among adults who have had COVID-19, October 2023



Data comes from the Household Pulse Survey conducted between October 18–30, 2023.

Source: Census Bureau accessed via CDC

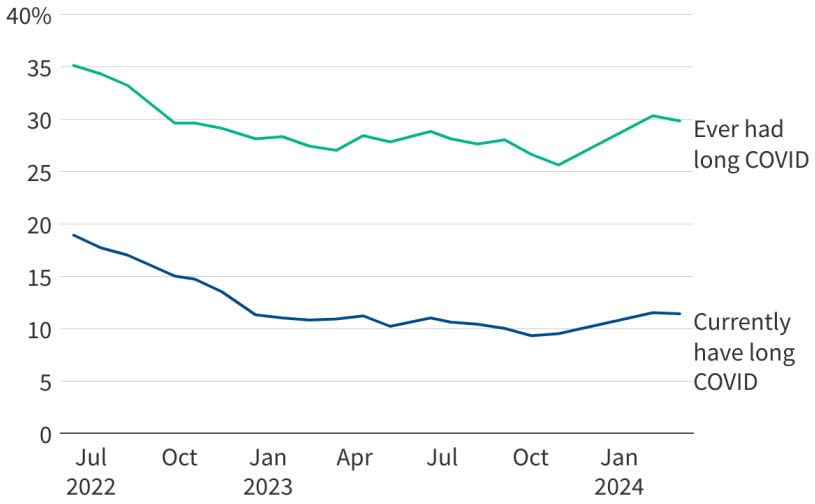
USAFACTS

Frequency of Long COVID

Figure 1

Around 3 in 10 Adults Who Have Had COVID Report Getting Long COVID

Percentage of adults reporting they currently or ever had long COVID among those who have had COVID



Note: The Pulse Survey, an experimental survey conducted by the Census Bureau and National Center for Health Statistics, asked respondents whether they had any symptoms of COVID that had lasted longer than 3 months. This figure reports the findings between 6/13/2022 and March 4, 2024.

Source: National Center for Health Statistics. Post-COVID Conditions. Data accessed March 28, 2024.

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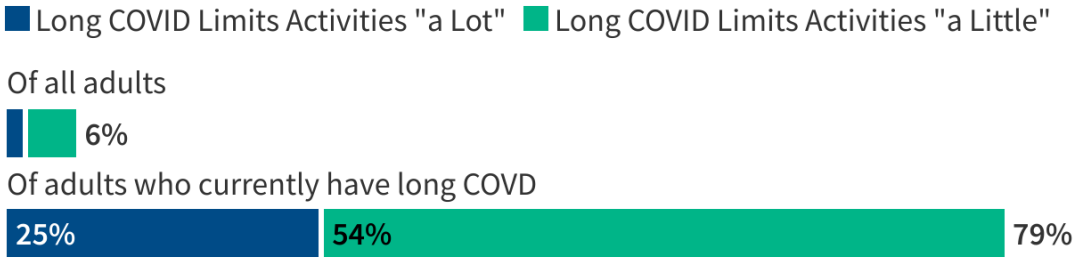
Figure 2

Most Adults with Long COVID Report that it Limits Their Activities at Least a Little

Percentage of adults reporting that they have activity limitations from long COVID as of March 4, 2024



Note: The Pulse Survey, an experimental survey conducted by the Census Bureau and National Center for Health Statistics, asked respondents whether they had any symptoms of COVID that had lasted longer than 3 months and among adults who respond "yes," whether the symptoms limit their day-to-day activities “a lot,” “a little,” or “not at all." The survey characterizies "a lot" responses as "significant" activity limitations.

Source: National Center for Health Statistics. Post-COVID Conditions. Data accessed March 28, 2024.

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How many people are we talking about?

FAIR Health®
Know Your Source

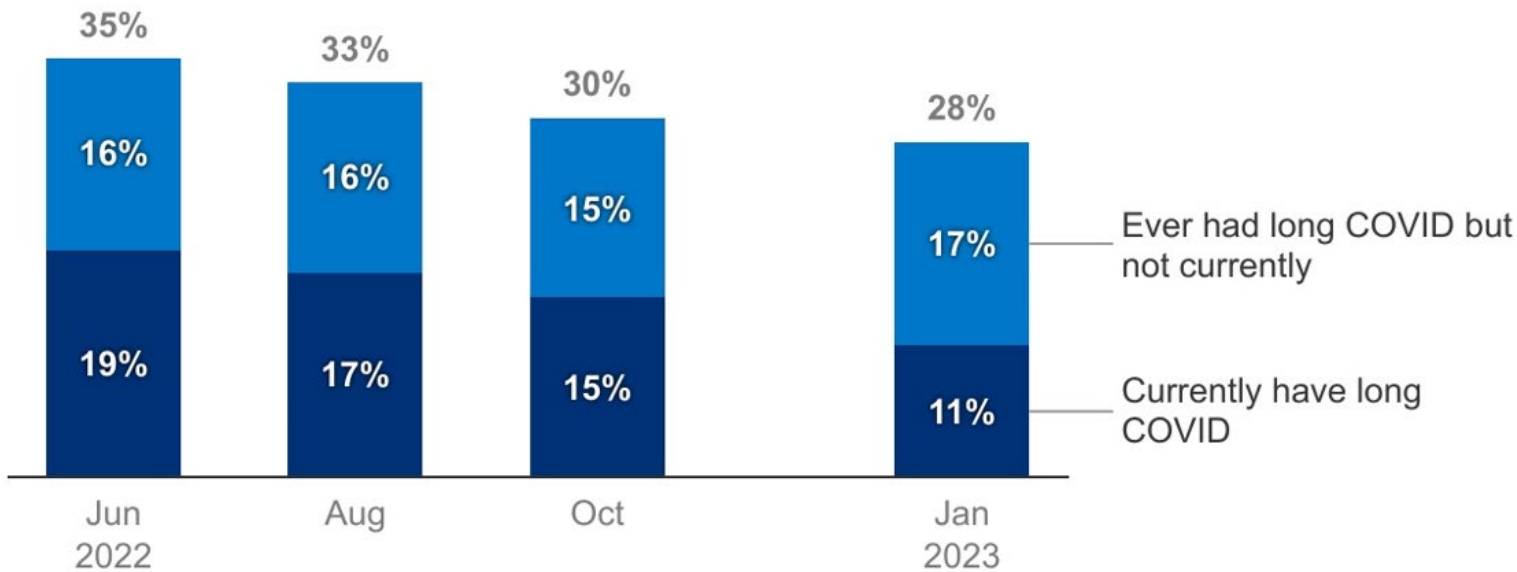
Table 1. Percent of patients with any post-COVID condition, by reaction type, March 2020-February 2021

	Percent of Patients with Any Post-COVID Condition
Total	23.19%
Asymptomatic	18.95%
Symptomatic	27.48%
Hospitalized	49.98%
Loss of Taste or Smell Only	0%

30 days or more

Among People Who Have Had COVID, the Percentage who Currently Have Long COVID is Declining

Percentage of people reporting that they currently have or ever had long COVID among those who have had COVID as of January 16, 2023



NOTE: The Pulse Survey, an experimental survey conducted by the Census Bureau and National Center for Health Statistics, asked respondents whether they had any symptoms of COVID that had lasted longer than 3 months. This figure reports the findings as of 6/13/2022, 8/8/2022, 10/17/2022, and 1/16/2023.
SOURCE: National Center for Health Statistics. Post-COVID Conditions. Data accessed Jan 26, 2023. Available from: https://data.cdc.gov/d/gsea-w83j.

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How Common Is Long COVID in Children and Adolescents?

REVIEW ARTICLES

How Common is Long COVID in Children and Adolescents?

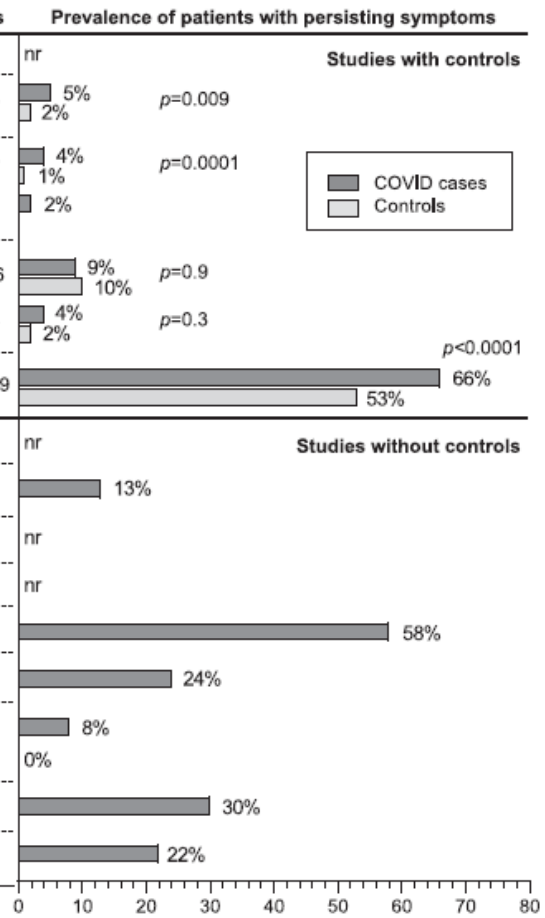
Zimmermann, Petra MD, PhD[*,†,‡,§]; Pittet, Laure F. MD-PhD[‡,§,¶]; Curtis, Nigel FRCPCH, PhD[‡,§,‖]

Author Information

The Pediatric Infectious Disease Journal 40(12):p e482-e487, December 2021. | **DOI:** 10.1097/INF.0000000000003328

- Risk is probably much lower that first reported
  - More like under 5% (or even lower) versus 25%
- 25-fold greater risk in children with obesity, kidney disease, cardiovascular disease, or immune disorder

First author	Country	Study	Age (y)[a]	Timing	Cases	Controls
Blankenburg	Germany	CS	median 15 (14-16)	nr	nr	nr
Miller	UK	PCS	nr, ≤17	4w	8/174	72/4504
Molteni	UK	PCS	median 13 (10-15)	4w	77/1734	15/1734
				8w	25/1734	nr
Radtke	Switzerland	PCS	median 11 (nr)	4w	10/109	121/1246
				12w	4/109	28/1246
Stephenson	UK	PCS	range 11-17	12w	2038/3065	1993/3739
Ashkenazi-Hoffnung	Israel	PCS	mean 12 (5)	[b]	90	-
Blomberg	Norway	PCS	median 8 (6-12)	5m	2/16	-
Brackel	Netherlands	CS	median 13 (9-15)	nr	89	-
Buonsenso	UK, USA	CS	mean 10 (3.8)	4w	510	-
Buonsenso	Italy	CS	mean 11 (4.4)	[c]	75/129	-
Osmanov	Russia	PCS	median 10 (3-15)	5m	126/518	-
Say	Australia	PCS	mean 3.7 (3.5)	4w	12/151	-
				12w	0/151	-
Smane	Latvia	RCS	mean 9.2 (5.2)	[d]	9/30	-
Sterky	Sweden	PCS	nr, ≤18	16w	12/55	-



[a] mean (SD), median (interquartile range), or range;
[b] median 112d after infection, range 33-410d
[c] mean 163d after infection, SD 114d
[d] mean 101d after infection, SD 17d

CS, cross-sectional study; d, days; m, month; nr, not reported; PCS, prospective cohort study; RCS, retrospective cohort study; SD, standard deviation; w, weeks; y, years

How Common Is Long COVID in Children and Adolescents?

REVIEW ARTICLES

How Common is Long COVID in Children and Adolescents?

Zimmermann, Petra MD, PhD[*,†,‡,§]; Pittet, Laure F. MD-PhD[‡,§,¶]; Curtis, Nigel FRCPCH, PhD[‡,§,‖]

Author Information

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- Headache (3 to 80%)
- Fatigue (3 to 87%)
- Sleep Disturbances (2 to 63%)
- Concentration Difficulties (2 to 81%)
- Abdominal Pain (1 to 76%)
- Myalgia or arthralgia (1 to 61%)

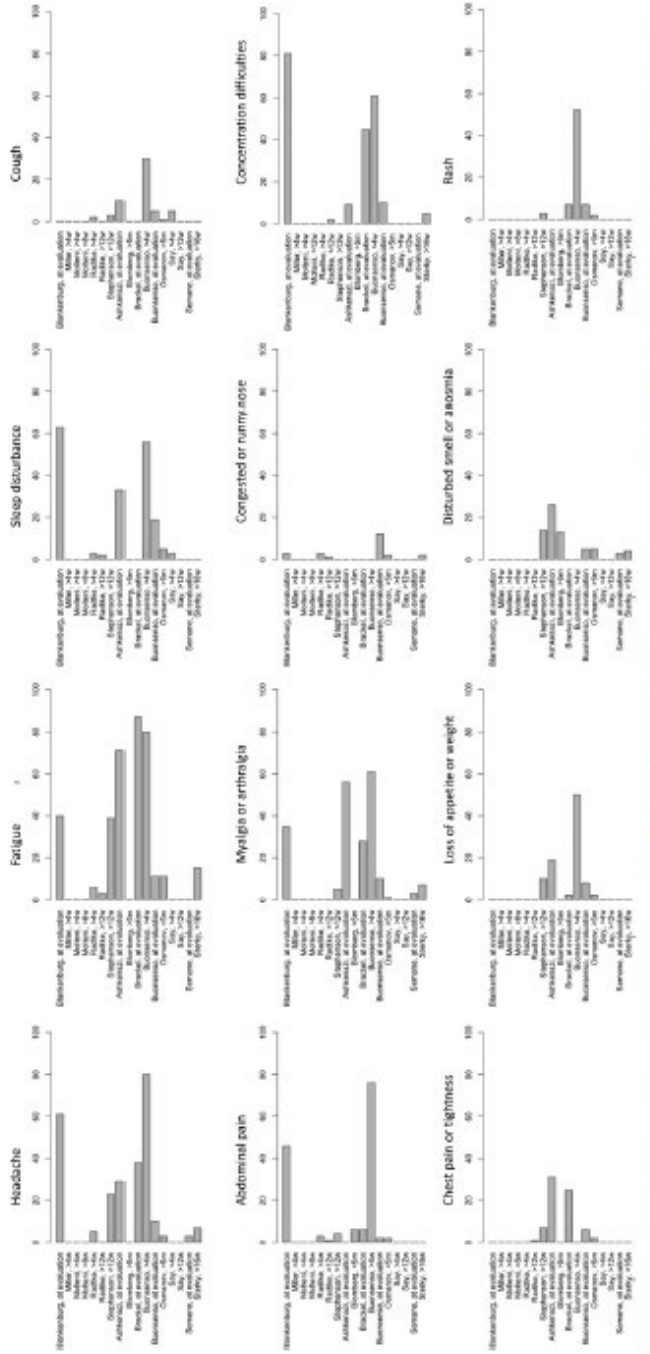


FIGURE 2. Most common reported persistent symptoms (%) after SARS-CoV-2 infection in children and adolescents (for studies in which a symptom was not reported bars are set at 0, except for Say, >12w when all children were asymptomatic).

Why is PEM so important?

- Post-exercise malaise
- Made prominent by ME/CFS

SIMON DÉCARY, PT, PhD[1] • ISABELLE GABOURY, PhD[2] • SABRINA POIRIER[3] • CHRISTIANE GARCIA[4]
SCOTT SIMPSON, BA, CWC[5] • MICHELLE BULL, PhD[6] • DARREN BROWN, MSc, MRes[7] • FRÉDÉRIQUE DAIGLE, MSc[1]

Humility and Acceptance: Working Within Our Limits With Long COVID and Myalgic Encephalomyelitis/ Chronic Fatigue Syndrome

JOURNAL OF ORTHOPAEDIC & SPORTS PHYSICAL THERAPY | VOLUME 51 | NUMBER 5 | MAY 2021 | 197

PATIENT-LED RESEARCH COLLABORATIVE

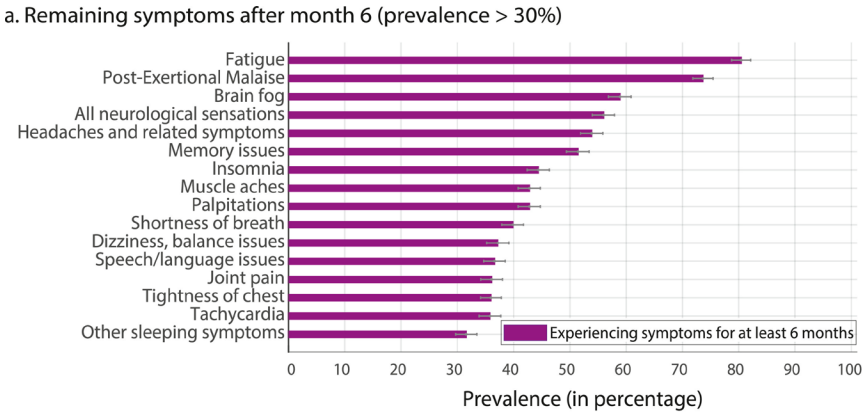
Characterizing long COVID in an international cohort: 7 months of symptoms and their impact

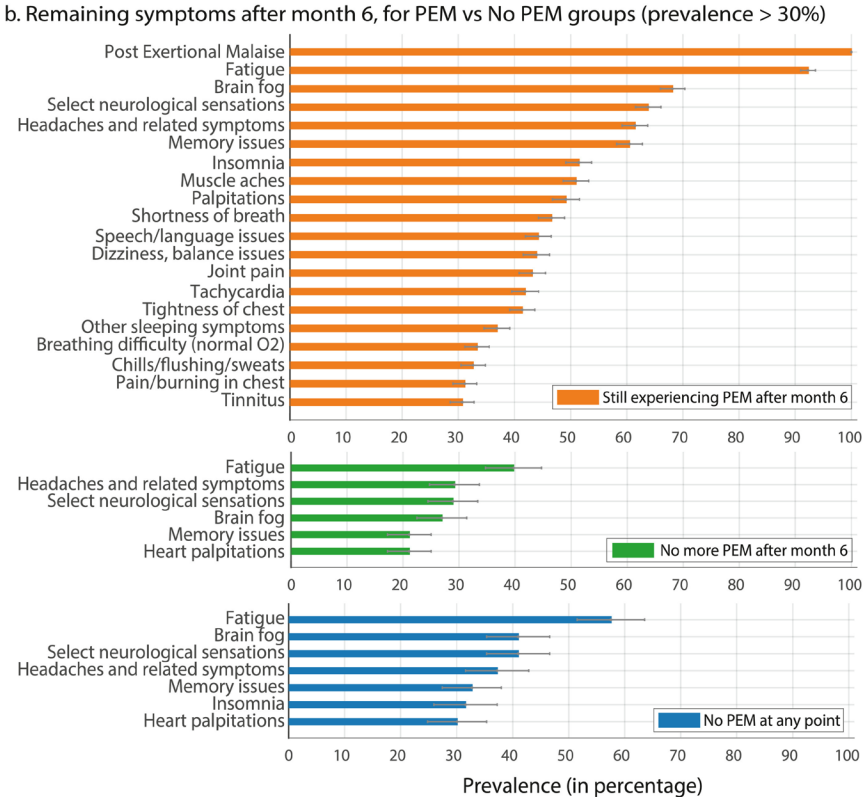
Hannah E. Davis[a,1], Gina S. Assaf[a,1], Lisa McCorkell[a,1], Hannah Wei[a,1], Ryan J. Low[a,b,1], Yochai Re'em[a,c,1], Signe Redfield[a], Jared P. Austin[a,d], Athena Akrami[a,b,1,*]

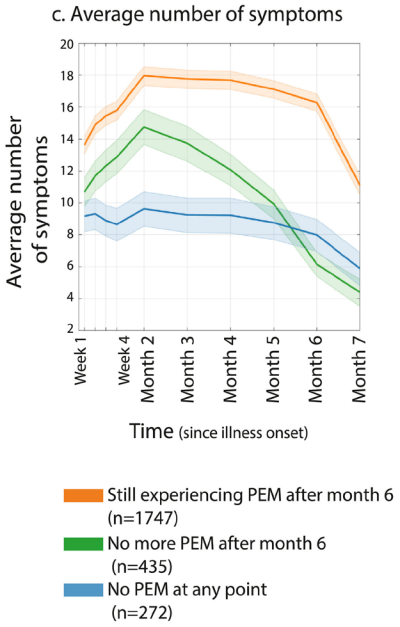
[a] *Patient-Led Research Collaborative*
[b] *Sainsbury Wellcome Centre, University College London, London, United Kingdom*
[c] *Department of Psychiatry, NewYork-Presbyterian Hospital / Weill Cornell Medicine, NYC, United States*
[d] *Oregon Health and Science University, Portland, OR, United States*

Notice how present Fatigue & PEM is a symptom

https://patientresearchcovid19.com/

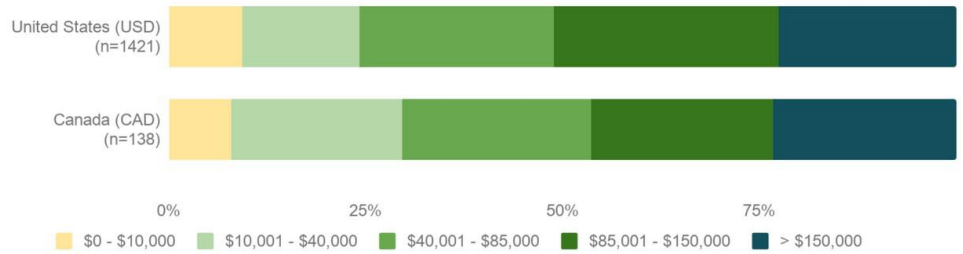




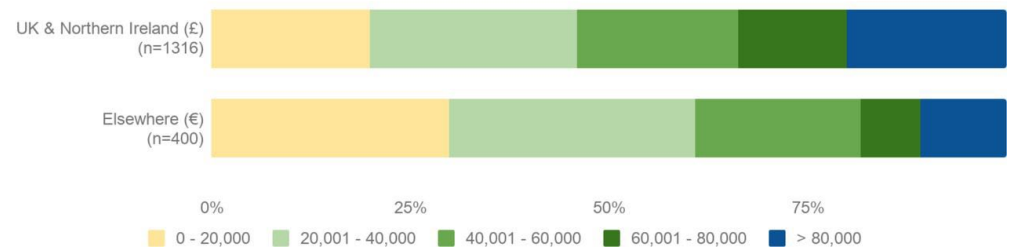


PATIENT-LED RESEARCH COLLABORATIVE

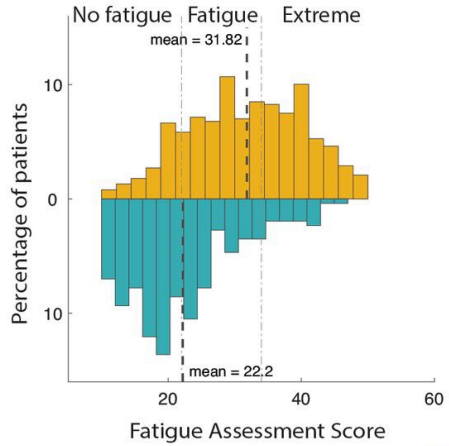
a. Income Brackets in USA / Canada



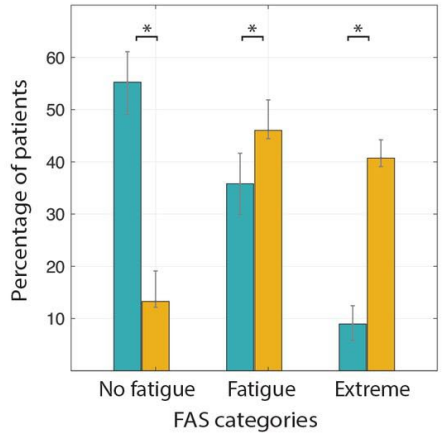
b. Income Brackets in UK / World

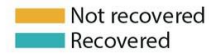


a. Fatigue Assessment Scale (FAS)

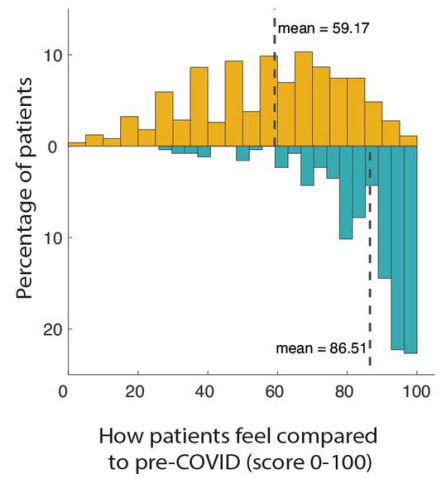


b. FAS categories (No fatigue, Fatigue & Extreme)

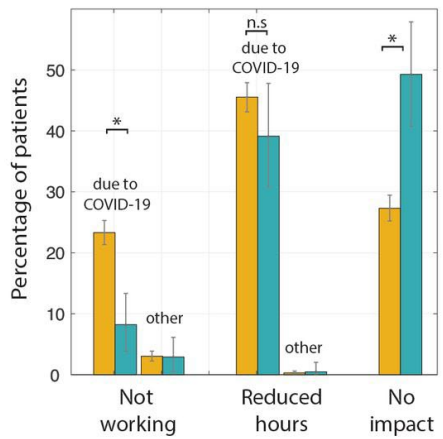




c. Return to pre-COVID baseline



d. LONG COVID impact on work



https://patientresearchcovid19.com/

PATIENT-LED RESEARCH COLLABORATIVE

#	SYMPTOM	%	CATEGORY
1	Fatigue	98.3	Systemic
2	Sensorimotor symptoms, overall	91.4	Neuropsychiatric – Sensorimotor
3	Post-Exertional Malaise	89.1	Systemic
4	Cognitive Dysfunction symptoms, overall	85.4	Neuropsychiatric – Cognitive Dysfunction
5	Brain fog	85.1	Neuropsychiatric – Cognitive Dysfunction
6	Sleep symptoms, overall	78.6	Neuropsychiatric – Sleep
7	Shortness of Breath	77.4	Pulmonary
8	Headaches, overall	76.7	Neuropsychiatric – Headaches
9	Poor attention or concentration	74.8	Neuropsychiatric – Cognitive Dysfunction
10	Tightness of Chest	74.8	Musculoskeletal

List goes to #209

https://patientresearchcovid19.com/

Early symptom clusters

Cluster A1 n=18331	Cluster A2 n=34978	
64.6	16.2	Appetite loss
61.5	13.4	Severe fatigue
68.9	22.8	Shortness of breath
59.3	15.1	Chills
45.5	15.9	Heavy arms/legs
64.0	22.8	Tight chest
53.5	13.8	Difficulty sleeping
38.2	11.8	Dizziness
30.4	15.6	Blocked nose
28.3	16.0	Runny nose
21.4	10.1	Diarrhoea
34.7	9.7	Chest pain
20.1	6.3	Nausea/vomiting
32.5	11.1	Hoarse voice
22.2	8.7	Sore eyes
18.4	6.3	Abdominal pain / belly ache
22.2	10.9	Sneezing
12.6	3.7	Numbness/tingling
6.4	2.8	Red, itchy areas on skin
1.4	0.4	Sudden swelling to face or lips
1.7	1.0	Purple sores/blisters on feet
41.3	26.9	Loss or change of sense of taste
36.3	25.6	Loss or change of sense of smell
73.3	40.1	New persistent cough
65.9	32.6	Sore throat
78.5	56.9	Tiredness
84.5	38.2	Muscle aches
81.0	39.7	Headache
81.5	32.0	Fever

Symptom prevalence: 100, 80, 60, 40, 20, 0

A1 A2

Symptom onset → 12 weeks after symptom onset

A1
n=18,331
High prevalence of all symptoms, especially muscle aches, headache, fever, appetite loss, cough, shortness of breath, and chills, at time of infection

A2
n=34,978
Lower prevalence of all symptoms, especially flu-like and respiratory, at time of infection

No symptoms
n=33,069
No persistent symptoms 12 weeks after symptom onset

L1: tiredness
n=15,799
High prevalence of tiredness

L2: respiratory
n=4,441
High prevalence of respiratory symptoms

Symptom clusters at 12 weeks

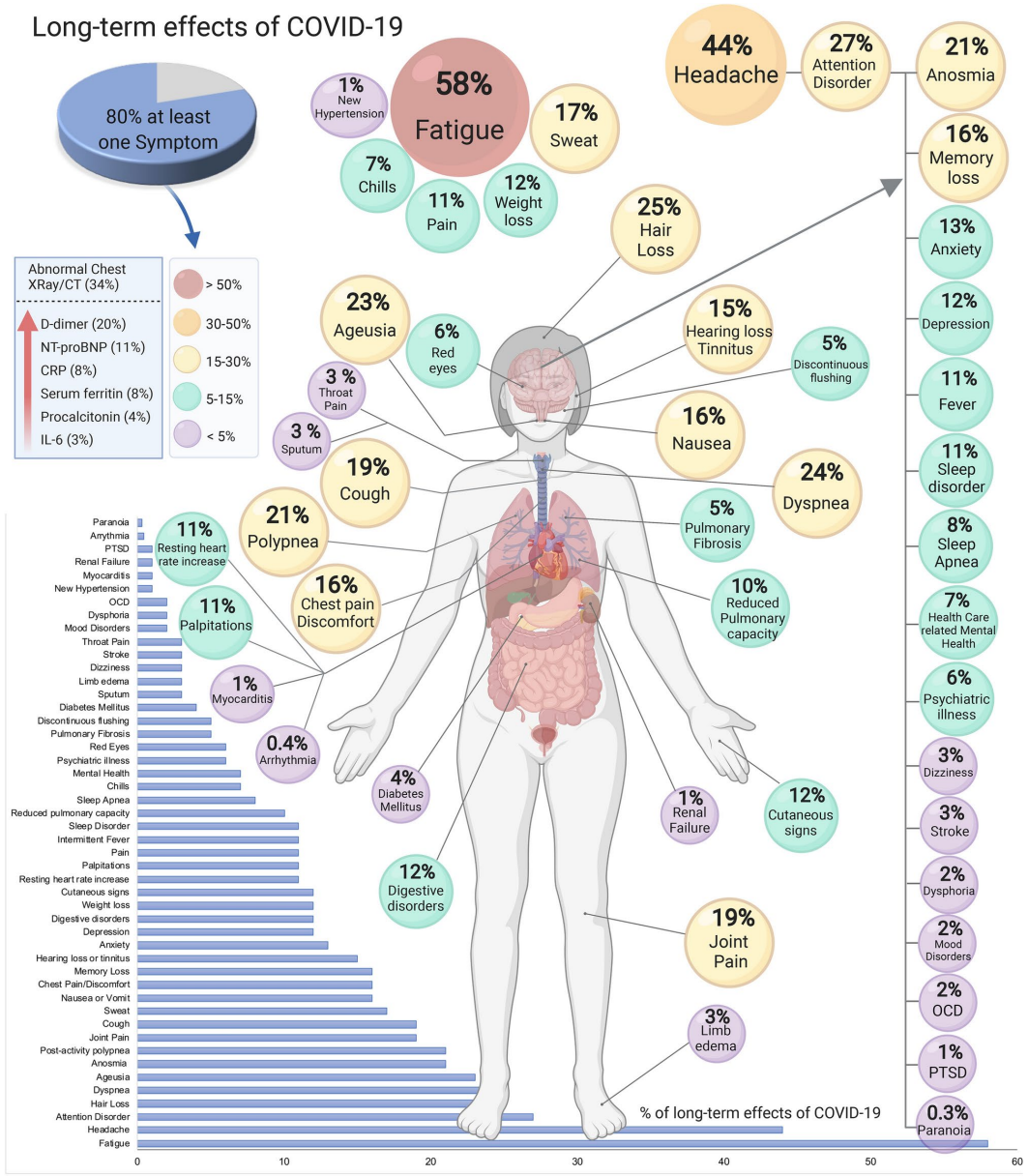
Cluster L1 n=15799	Cluster L2 n=4441	
7.1	9.0	Appetite loss
6.7	12.9	Severe fatigue
11.1	85.8	Shortness of breath
3.0	4.5	Chills
7.7	12.5	Heavy arms/legs
3.1	61.2	Tight chest
19.8	21.0	Difficulty sleeping
7.5	12.3	Dizziness
7.7	8.5	Blocked nose
7.2	6.0	Runny nose
3.6	3.7	Diarrhoea
3.0	20.9	Chest pain
2.0	3.2	Nausea/vomiting
5.0	9.1	Hoarse voice
7.5	9.1	Sore eyes
3.7	6.0	Abdominal pain / belly ache
5.7	5.0	Sneezing
5.1	7.9	Numbness/tingling
3.1	3.4	Red, itchy areas on skin
0.2	0.5	Sudden swelling to face or lips
0.8	0.9	Purple sores/blisters on feet
12.5	9.3	Loss or change of sense of taste
15.5	9.8	Loss or change of sense of smell
9.6	16.6	New persistent cough
7.7	8.8	Sore throat
50.8	29.1	Tiredness
18.7	23.7	Muscle aches
13.9	15.3	Headache
2.9	4.8	Fever

L1 L2

More than 50 long-term effects of COVID-19: a systematic review and meta-analysis

Sandra Lopez-Leon[1], Talia Wegman-Ostrosky[2], Carol Perelman[3], Rosalinda Sepulveda[4], Paulina A. Rebolledo[5,6], Angelica Cuapio[7] & Sonia Villapol[8,9]✉

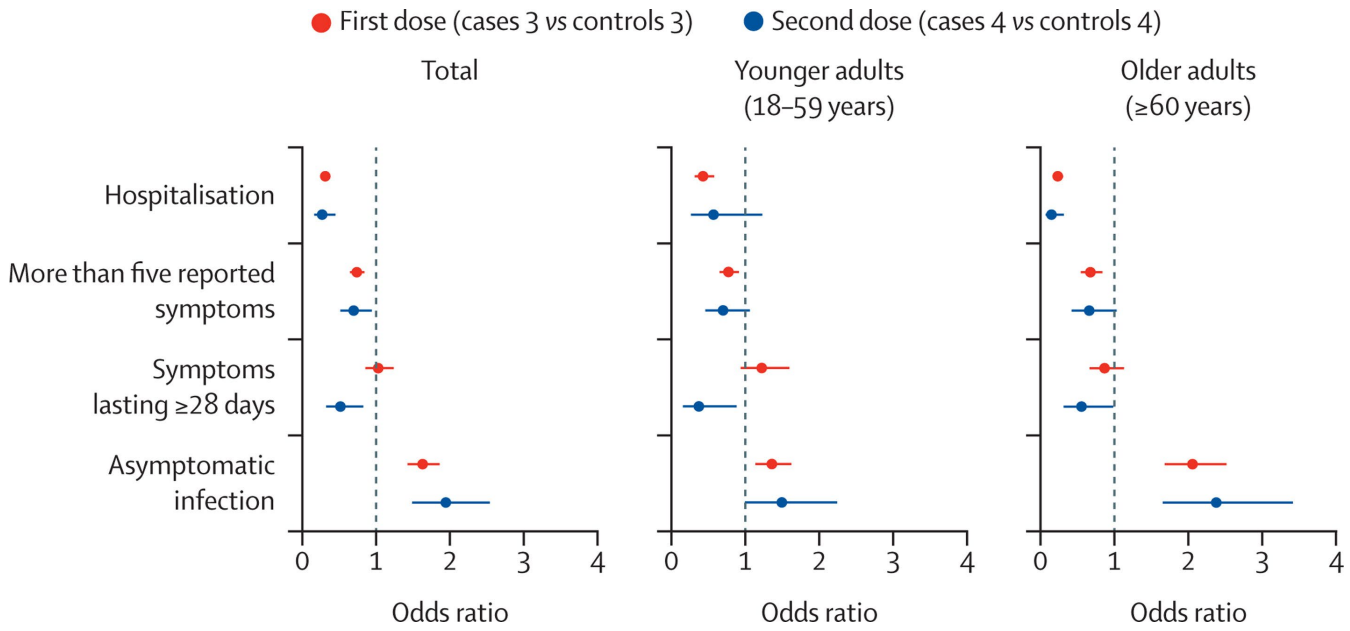
Scientific Reports | (2021) 11:16144



What if you are vaccinated and get COVID-19?

Risk factors and disease profile of post-vaccination SARS-CoV-2 infection in UK users of the COVID Symptom Study app: a prospective, community-based, nested, case-control study

- Risk seems to be reduced by half if fully vaccinated.



Revisiting the Primary Targets for Rehab Intervention

- Fatigue – PEM & general
- Cardiac Function (Tachycardia)
- Dysautonomia
- Brain Fog
- Oxygen Saturation/Ventilation Abnormalities
- Coughing/Hoarseness
- Psychosocial/Spiritual

Potential Pathophysiologic Mechanisms

- Ability to infect many cells
- Viral Reservoirs
- Immunosuppressive activity of SARS-CoV-2
- “Dysbiosis” of microbiome

SARS-CoV-2’s acute actions may inform the long-term impact

Long COVID or Post-acute Sequelae of COVID-19 (PASC): An Overview of Biological Factors That May Contribute to Persistent Symptoms

*Amy D. Proal[1] and Michael B. VanElzakker[1,2]**

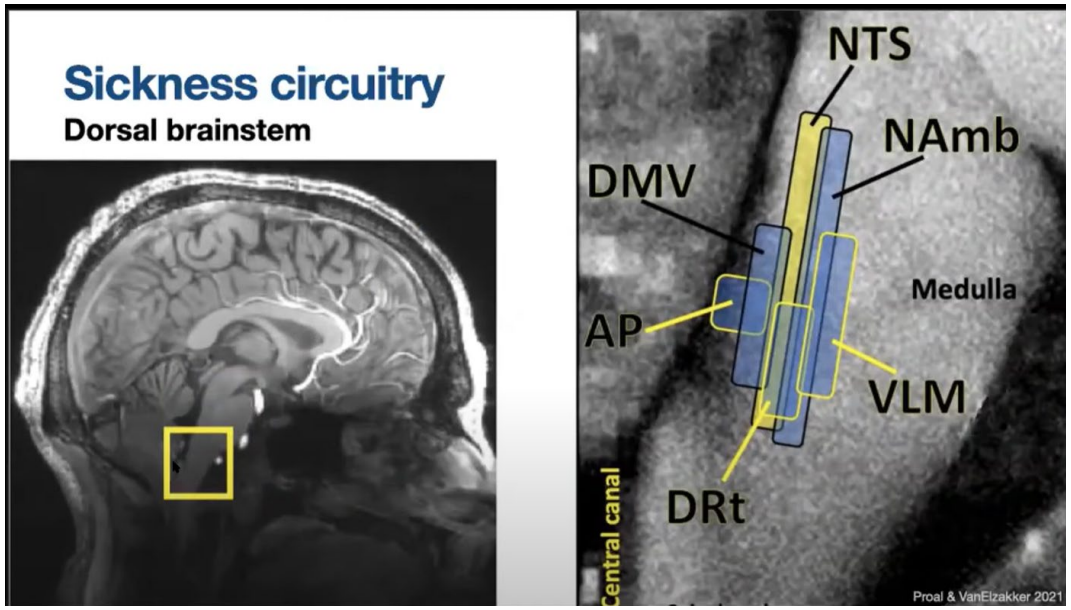
[1] PolyBio Research Foundation, Kenmore, WA, United States, [2] Division of Neurotherapeutics, Massachusetts General Hospital, Harvard Medical School, Boston, MA, United States

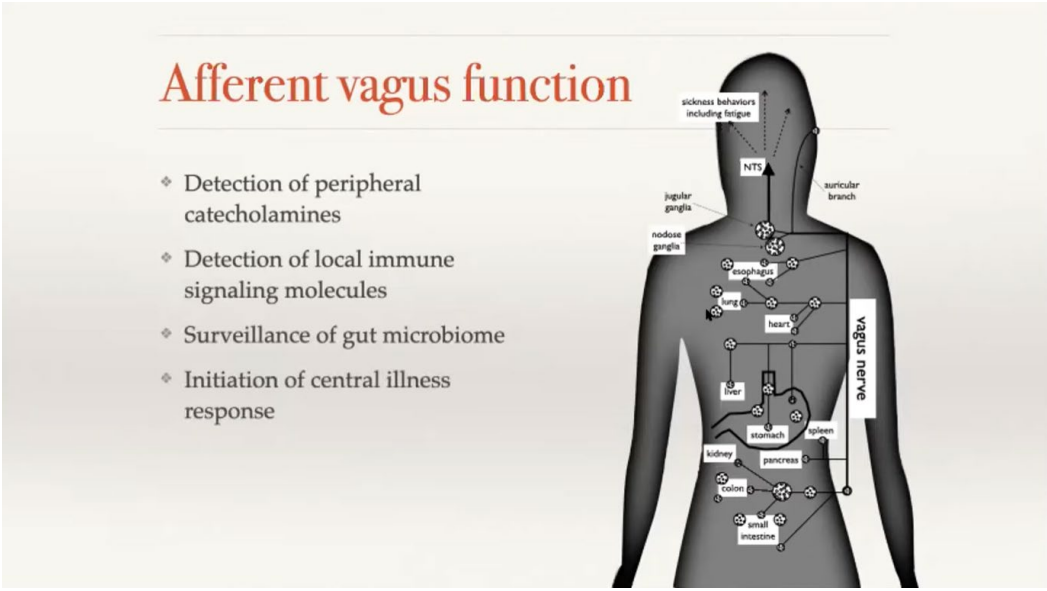
Frontiers in Microbiology | www.frontiersin.org

June 2021 | Volume 12 | Article 698169

How can these desperate problems drive similar symptoms?

- The Neuroscience of Feeling Sick
- Vagus Nerve acts as diffuse sensory organ

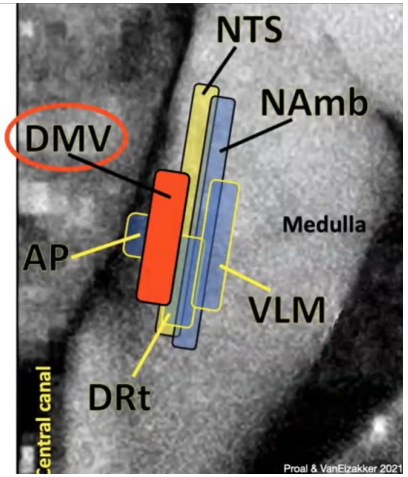




How can these desperate problems drive similar symptoms?

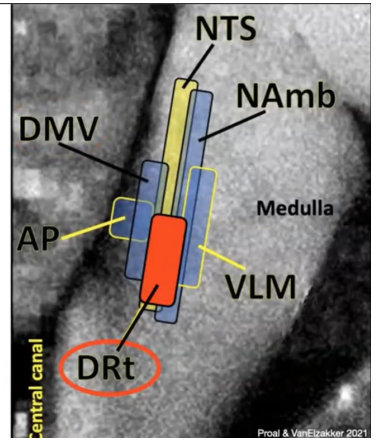
Dorsal motor nucleus of vagus nerve

- Autonomic
- Site of parasympathetic soma
- Main source of vagal innervation of trunk organs



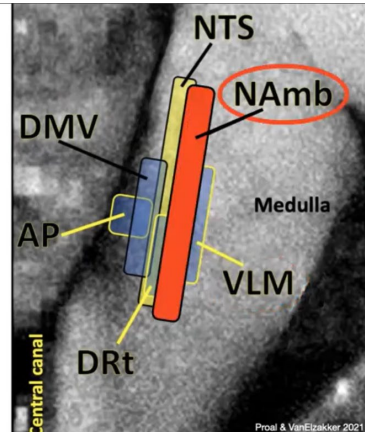
Dorsal reticular nucleus

- Inflammatory pain transmission



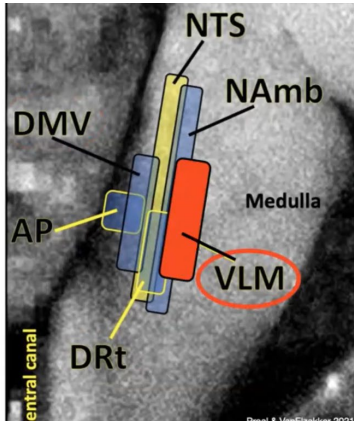
Nucleus ambiguus

- Contains soma of cholinergic preganglionic parasympathetic neurons that control heart rate

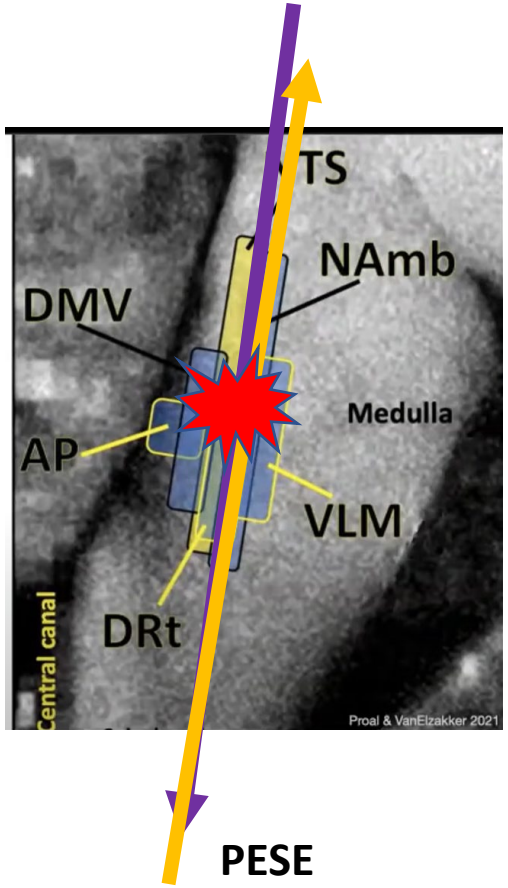


Ventrolateral medulla

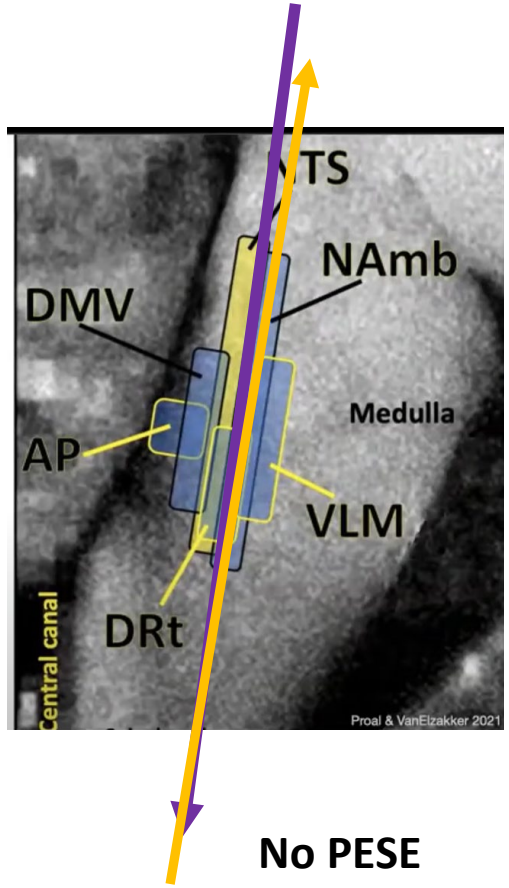
- Involved in noradrenergic sympathetic nervous system signaling
- Autonomic control of blood pressure and breathing



How could physical/mental activity be causing these outcomes?



PESE



No PESE

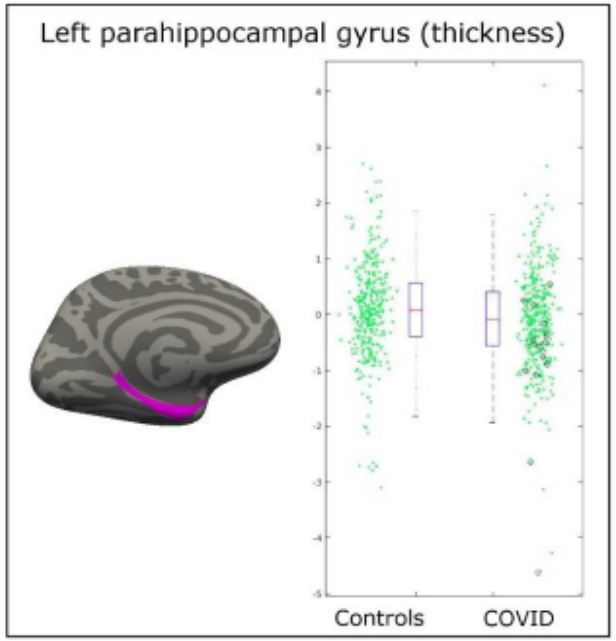
Post-Exertional Symptom Exacerbation (PESE)

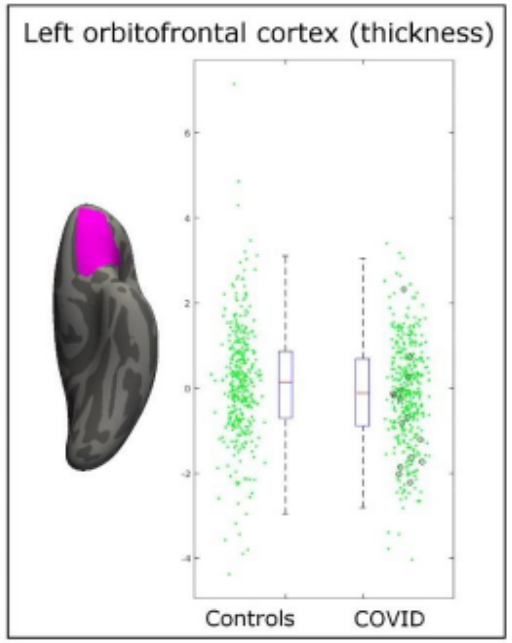
Changes i n

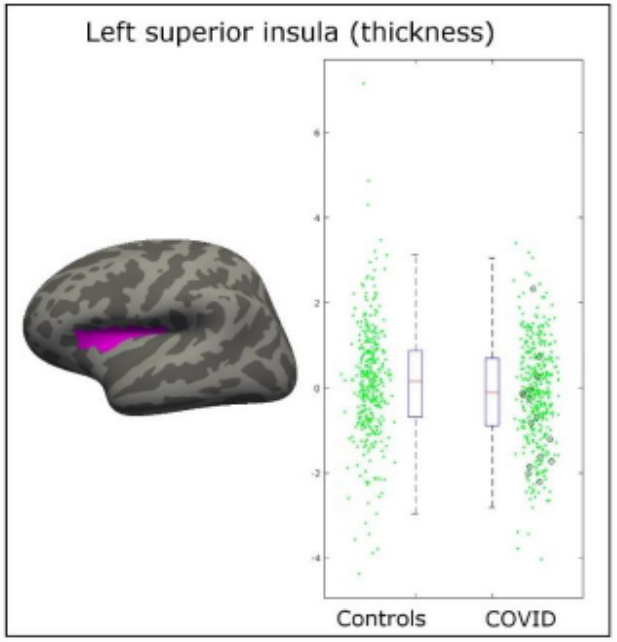
Memory of events (Objects & Temporal sequence)

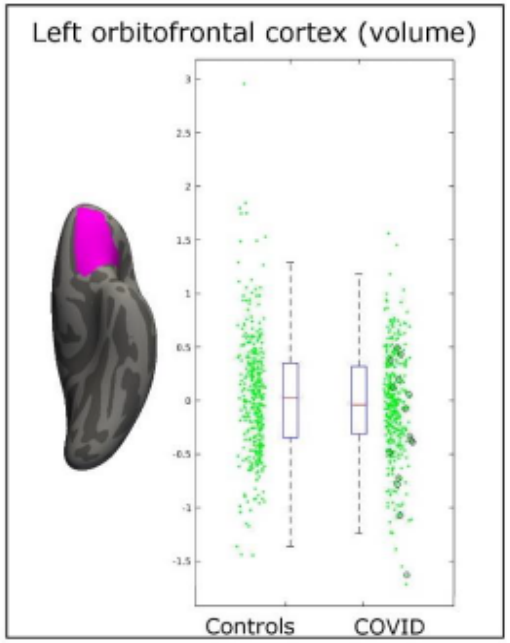
Gwenaëll
Wang[1], Frederik Lange[1], Jesper L.R. Andersson[1], Ludovica Griff
Jbabdi[1], Bernd Taschler[1], Anderson Winkler[4], Thomas E. Nich
Matthews[7], Naomi Allen[6], Karla L. Miller[1], Steph

- Primary gustatory cortex





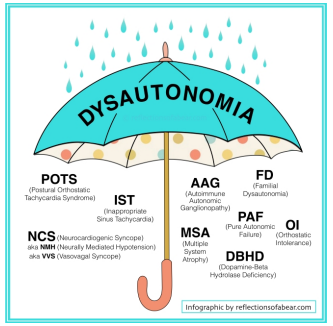


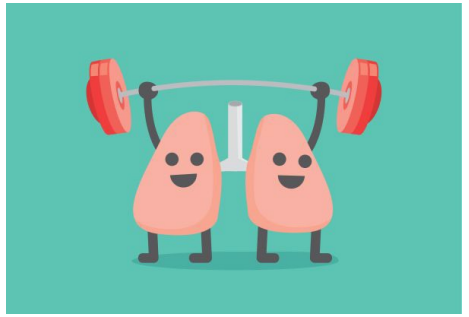


- Connects all 4 primary olfactory regions

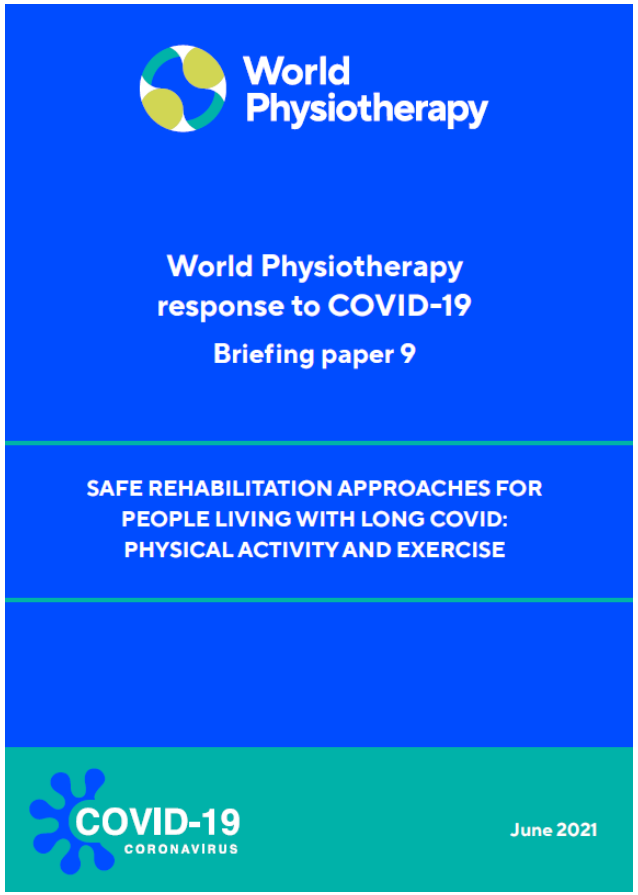
Rehab Approach – Facilitated Adaptation

- Shared decision-making model
- Patient Centered
- Multidisciplinary





Two Particularly Helpful Documents



Rehabilitation for Clients with Post COVID-19 Condition (Long COVID)

Guidance for Canadian Rehabilitation and Exercise Professionals

World Physiotherapy

World Physiotherapy response to COVID-19

Briefing paper 9

SAFE REHABILITATION APPROACHES FOR PEOPLE LIVING WITH LONG COVID: PHYSICAL ACTIVITY AND EXERCISE

COVID-19 CORONAVIRUS

June 2021

World Physiotherapy

Safe rehabilitation

- **Post-Exertional Symptom Exacerbation:** before recommending physical activity (including exercise or sport) as rehabilitation interventions for people living with Long COVID, individuals should be screened for post-exertional symptom exacerbation through careful monitoring of signs and symptoms both during and in the days following increased physical activity, with continued monitoring in response to any physical activity interventions.

- **Cardiac Impairment:** exclude cardiac impairment before using physical activity (including exercise or sport) as rehabilitation interventions for people living with Long COVID, with continued monitoring for potential delayed development of cardiac dysfunction when physical activity interventions are commenced.

- **Exertional Oxygen Desaturation:** exclude exertional oxygen desaturation before using physical activity (including exercise or sport) as rehabilitation interventions for people living with Long COVID, with continued monitoring for signs of reduced oxygen saturation in response to physical activity interventions.

- **Autonomic Dysfunction and Orthostatic Intolerances:** Before recommending physical activity (including exercise or sport) as rehabilitation interventions for people living with Long COVID, individuals should be screened for autonomic nervous system dysfunction, with continued monitoring for signs and symptoms of orthostatic intolerance in response to physical activity interventions.

Rehabilitation Approach

- Clinical complexity and uncertainty = patient-centered personalized approach
- Education about resuming daily activities at appropriate pace that is safe and manageable (avoid or minimize PEM)
- "***Stop, Rest, Pace***" and heart rate monitoring to manage symptoms
- Avoid O_2sat drop with exertion, **≥3% should be investigated**
- Orthostatic Hypotension
  - Autonomic conditioning therapy
  - Non-upright exercise
  - Isometric exercise
  - Compression garments
  - Patient education

Sustained Symptom Stabilization and Reduction

World Physiotherapy

DePaul Symptom Questionnaire (adapted)

Symptoms	Frequency: Throughout the **past 6 months**, **how often** have you had this symptom? For each symptom listed below, circle a number from: **0 = none of the time** **1 = a little of the time** **2 = about half the time** **3 = most of the time** **4 = all of the time**	Severity: Throughout the **past 6 months**, **how much** has this symptom bothered you? For each symptom listed below, circle a number from: **0 = symptom not present** **1 = mild** **2 = moderate** **3 = severe** **4= very severe**
1. Dead, heavy feeling after starting to exercise	0 1 2 3 4	0 1 2 3 4
2. Next day soreness or fatigue after non-strenuous, everyday activities	0 1 2 3 4	0 1 2 3 4
3. Mentally tired after the slightest effort	0 1 2 3 4	0 1 2 3 4
4. Minimum exercise makes you physically tired	0 1 2 3 4	0 1 2 3 4
5. Physically drained or sick after mild activity	0 1 2 3 4	0 1 2 3 4

- **Score of 2 on both frequency and severity = PEM**

DePaul Symptom Questionnaire (adapted)

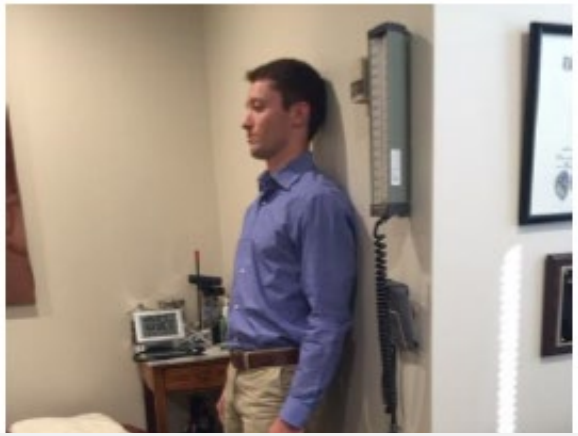
Supplementary Questions

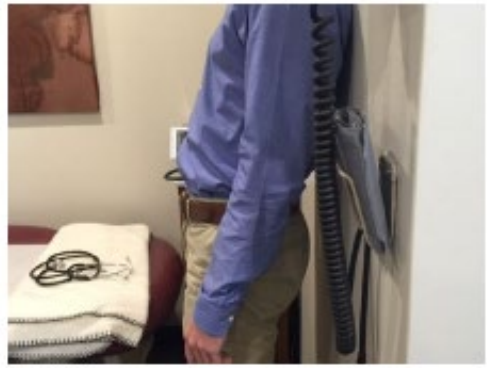
6. If you were to become exhausted after actively participating in extracurricular activities, sports, or outings with friends, would you recover within an hour or two after the activity ended?		Yes			No	
7. Do you experience a worsening of your **fatigue/energy related illness** after engaging in minimal physical effort?		Yes			No	
8. Do you experience a worsening of your **fatigue/energy related illness** after engaging in mental effort?		Yes			No	
9. If you feel worse after activities, how long does this last?	≤1 h	2–3 h	4–10 h	11–13 h	14–23 h	≥ 24 h
10. If you do not exercise, is it because exercise makes your symptoms worse?		Yes			No	

NASA 10 Minute Lean Test for OH

Orthostatic Vital Signs/The NASA 10-minute Lean Test

	Blood Pressure (BP)		Pulse	Comments
	Systolic	Diastolic		
Supine 1 minute				
Supine 2 minute				
Standing 0 minute				
Standing 1 minute				
Standing 2 minute				
Standing 3 minute				
Standing 4 minute				
Standing 5 minute				
Standing 6 minute				
Standing 7 minute				
Standing 8 minute				
Standing 9 minute				
Standing 10 minute				





Orthostatic hypotension (OH) (lowered blood pressure upon standing) was defined as a decrease in systolic blood pressure (SBP) 20 mm Hg or more, or a decrease in diastolic blood pressure (DBP) of 10 mm Hg or more in the first 3 minutes.

Postural orthostatic tachycardia syndrome (POTS) was defined as a heart rate increase of >30 beats per minute (bpm) upon standing or a heart rate of greater than 120 bpm.

Energy Envelope

- Avoid “Pushing & Crashing” and Post-Exertional Malaise (PEM)
- Spread out activity with rest in-between
- http://www.cfsselfhelp.org/pacing-tutorial
- Post-Exertional Symptom Exacerbation (PESE)
- Titration of Physical Activity vs Graded Exercise

Evaluation of Aerobic Capacity

- 6-MWT
- 2-MWT
- 2-minute step test
- Encouraged to Track Fatigue after test

Example Case

- 58 yo, female
- 5’2”, 196 lbs
- March 2021
- Meds
  - Telmisartan 40mg
  - Atenolol 25 mg
  - Synthyroid 200 mg

- Home Based Walking Program
  - Dizziness & Excessive Fatigue
- HR=78, O2sat=98, BP=178/94
- Modest 5 min Intervals
  - 2 to 2.5 mph, 0-3% grade
  - Mild Dyspnea, HR=111, O2sat=96, BP=192/92, RPE=3-4, Borg Breathlessness=4
  - Sudden onset of dizziness
    - BP=212/102
    - O2Sat=94
    - HR=94

Example Case

- Retreat to sub PESE
- Avoid dizziness
- Everyday monitoring of fatigue
- Review med with Cardiologist
  - BP goal not met
  - Dizziness with elevated BP
  - SOB

ELON UNIVERSITY

DEPARTMENT OF Physical Therapy Education

The Effect of Exercise Training on Long COVID-19

Brown M, Megurdichian M, Milgrom S, and Bailey S. ***Elon University, Elon, NC.***

Methods

Twelve participants (9 females, 3 males) completed the study. Before and after the intervention participants were assessed for 6-minute walk distance (6MWD), 5-times sit to stand (5XSTS), gait speed, grip strength, perceived quality of life (SF-12), and general fatigue (visual analog fatigue scale, VAFS). Participants then completed a progressive, individualized exercise program (~8 weeks) designed to improve cardiovascular fitness, muscle strength, and endurance. Modes of exercise used to facilitate improvement in cardiorespiratory fitness included the treadmill, NuStep, semi-recumbent bike, semi-recumbent elliptical, stand-up elliptical. Heart rate, blood pressure, O_2 saturation, and rating of perceived exertion were regularly monitored during aerobic exercise. Dumbbell exercises targeted at large muscle groups were used to challenge muscular strength and endurance. Progression of exercise intensity and duration was based on symptom response to exercise. Paired t-tests were used to evaluate changes in outcome measures following the intervention.

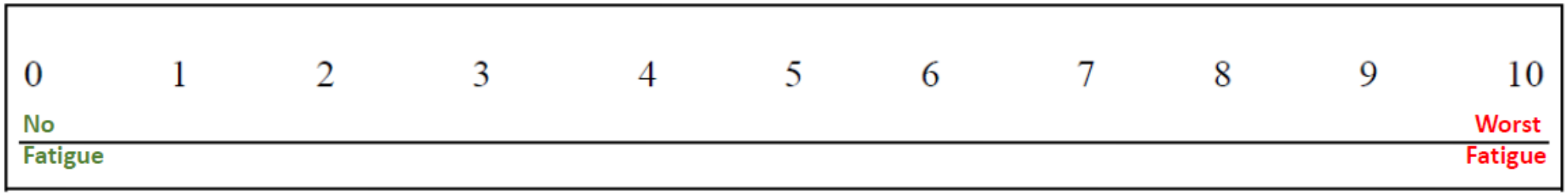
Intervention Plan

Week	Intervention
1	PT Eval
2	One Session
3	One Session
4	Two Sessions
5	Two Sessions
6	Three Sessions
7	Three Sessions
8	Three Sessions
9	Three Sessions

Evaluation of General Fatigue

VISUAL ANALOGUE FATIGUE SCALE (VAFS)

Please mark an "X" on the number line which describes your global fatigue with 0 being "no fatigue" and 10 being the worst.



Before Treatment, IP Treatment, 24 & 48 hours After Treatment

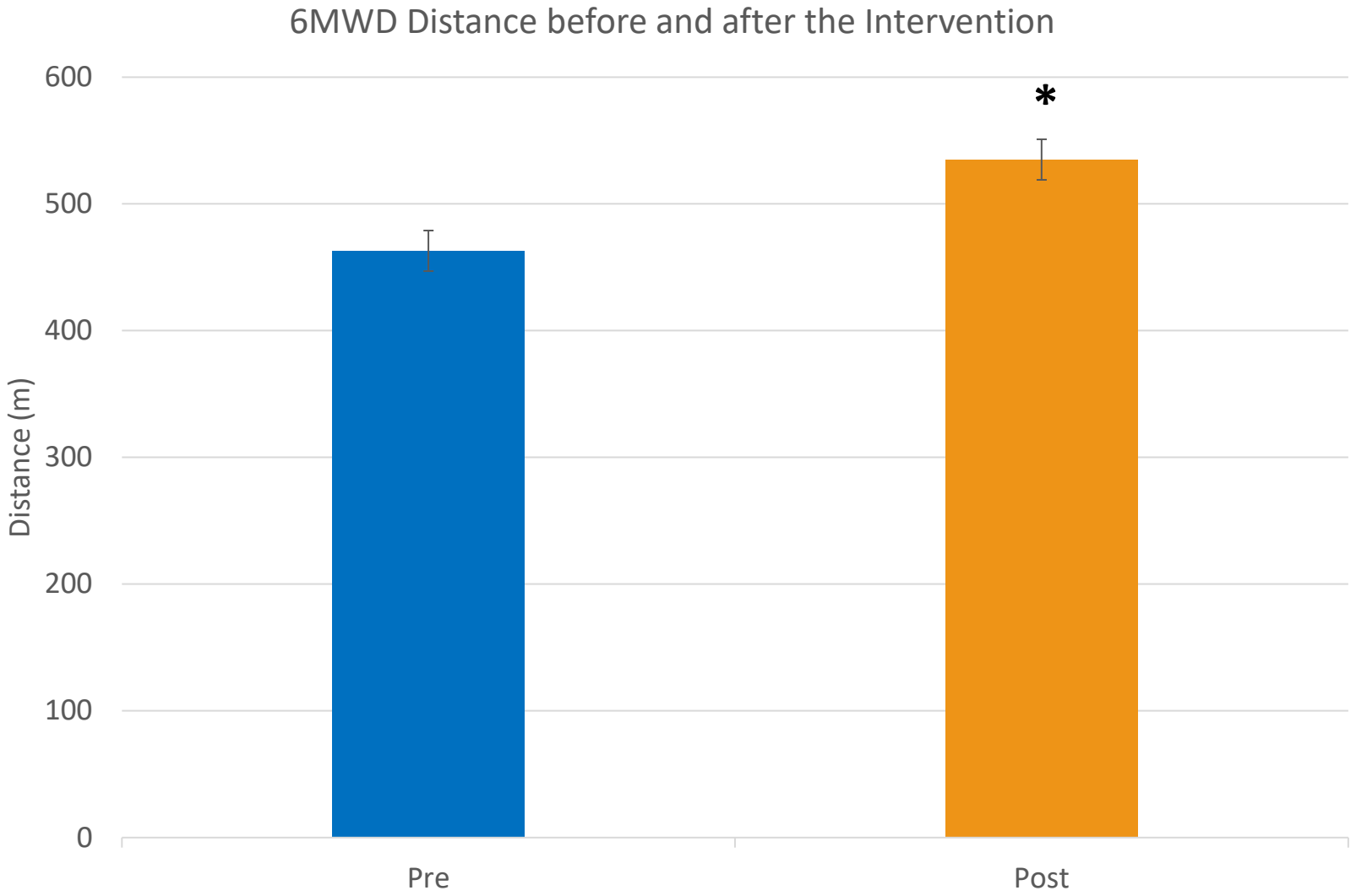


Figure 1. * indicates significant difference between pre and post (p=0.001)

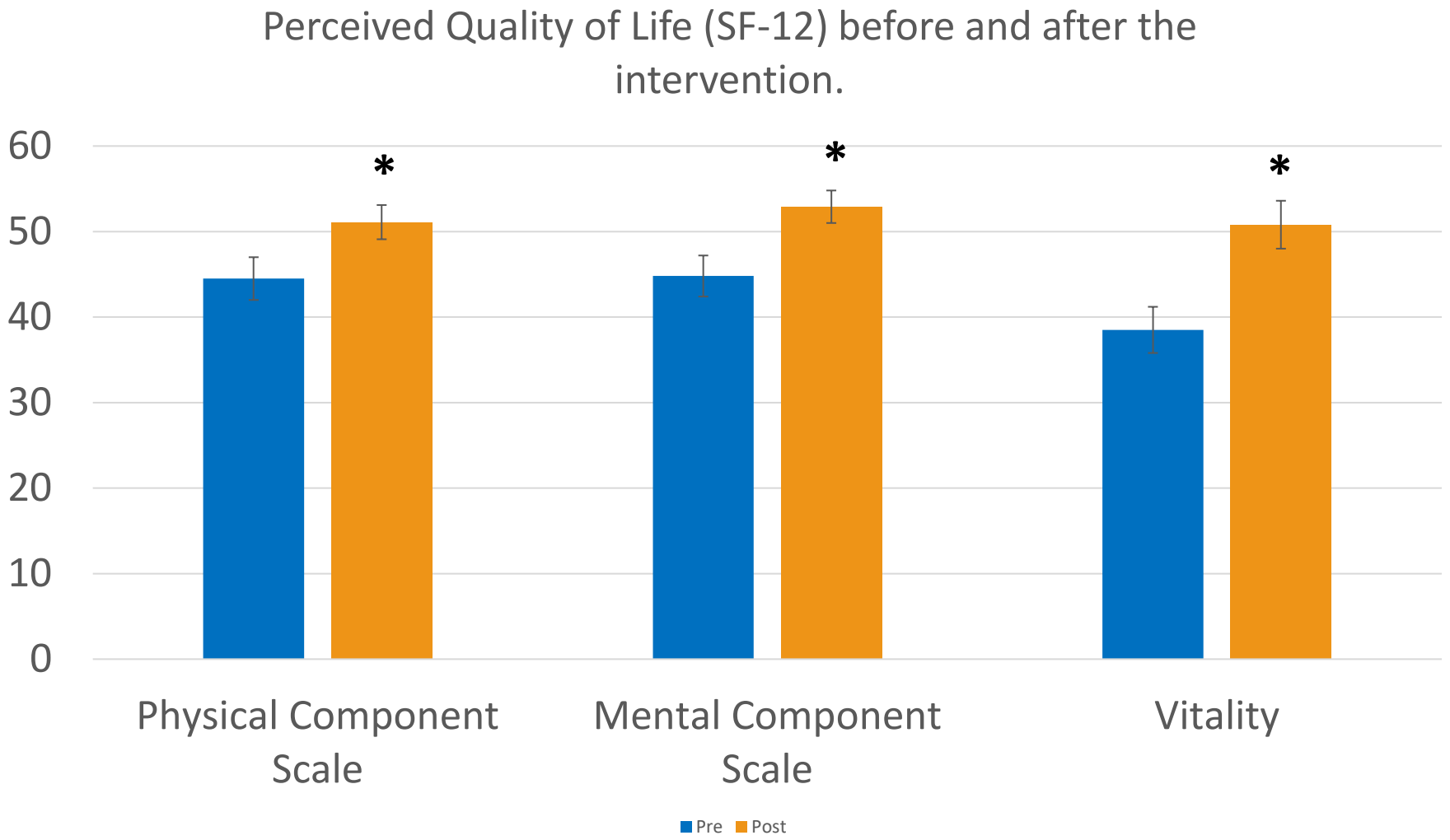


Figure 2. * indicates significant difference between pre and post (p=0.006, 0.007, 0.013)

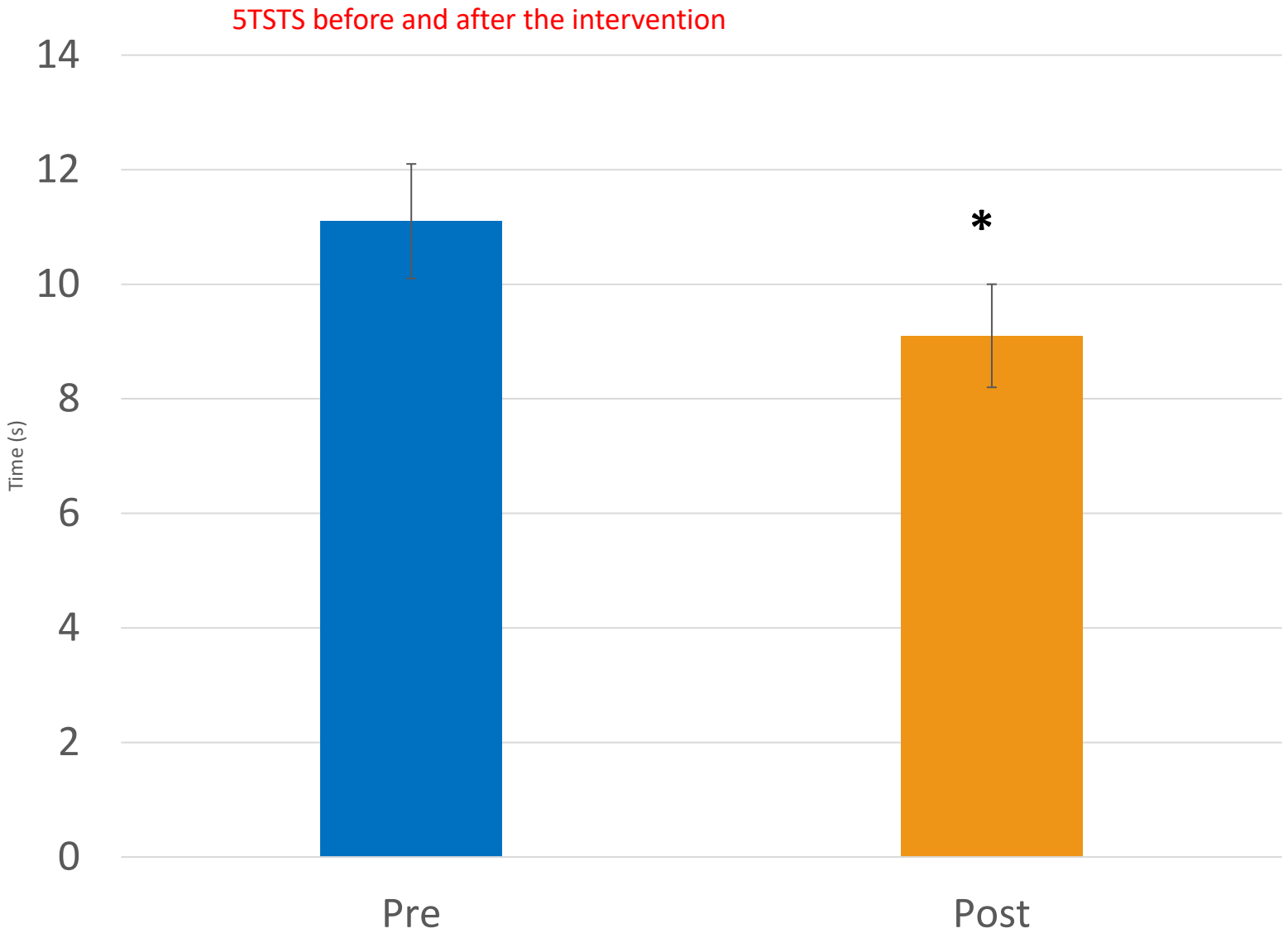


Figure 3. * indicates significant difference between pre and post (p=0.027)

	Pre	Post
Grip Strength* (lbs)		
R	72.3±4.2	76.0±4.3
L	66.5±3.4	70.6±3.2
5TSTS* (sec)	11.1±1.0s	9.1±0.9s
Gait Speed* (m/s)	1.23±0.04	1.36±0.06
VAFS*	5.0±0.5	2.8±0.4

Closing Thoughts & Opinions

- Probably operating on an unstable landscape for a while
- Wide diversity in time course and presentation
- “Equifinality” is an interesting premise
- The path to Long COVID is probably not the path to optimal function
- We can learn from pulmonary rehab, interventions for POTS, and ME/CFS
- Length of time between Dx and intervention may be important
- Tools are already available

baileys@elon.edu

Interesting Podcasts

LONG COVID PHYSIO