When exercise isn't indicated but rehab is - Long Covid

Dr Michelle Bull, Dr Nicola Clague-Baker, Natalie Hilliard

@physiosforme

www.physiosforme.com

Our backgrounds

- Specialist areas:
  - Physical activity promotion and exercise
  - Cardiac rehab
  - Cancer rehab
  - Neurological rehab
  - Msk rehab
  - Long covid and ME rehab

- Physios For ME 2019

Objectives

- Long COVID and PVFS post-COVID19
  - Incidence, demographics and symptoms
  - What can we learn from PVFS and ME?
- Fatigue, PVF, PVFS and ME
  - Definition, causes, general management
  - What do we know already?
  - Particular focus on exercise

Long COVID

What do we know so far?

What is long COVID?

These symptoms may be due to four different syndromes:

- permanent organ damage to the lungs and heart
- post-intensive-care syndrome
- continuing Covid-19 symptoms
- post-viral fatigue syndrome

National Institute for Health Research Themed Review – Living with COVID19

https://evidence.nihr.ac.uk/themedreview/living-with-covid19/

PVFS post COVID19 - incidence

Not clear due to lack of testing however:

- 30,827,305 *counted* cases. (20/9/20)
- Minus 958,514 deaths = 29,868,791 (20/9/20)
- Applying a conservative estimate of 2% (COVID Symptom App) for symptoms at 3 months = 5,973,758

- #longhaulers #longcovid #covid1in20 – 3.5K #apresJ20 #MitCoronaLeben
- @long_covid (facebook) – 22K members
- www.wearebodypolitic.com – 8K members

How many will recover? How many will develop ME?

PVFS post COVID19 – who are they?

Docherty et al (2020)

- From Feb to April 2020 in UK - 300,000 cases
- 16,749 hospitalized patients over 66 hospitals (14%)
- 7000 admitted to ITU (2%)
- **Over 80% not admitted to hospital**
- **These are the ones developing PVFS or long covid19**
- https://patientresearchcovid19.com/research/report-1/#Hospitalization

- Majority 30 – 49 years old (63%)
- 68% moderately to very physically active before COVID19

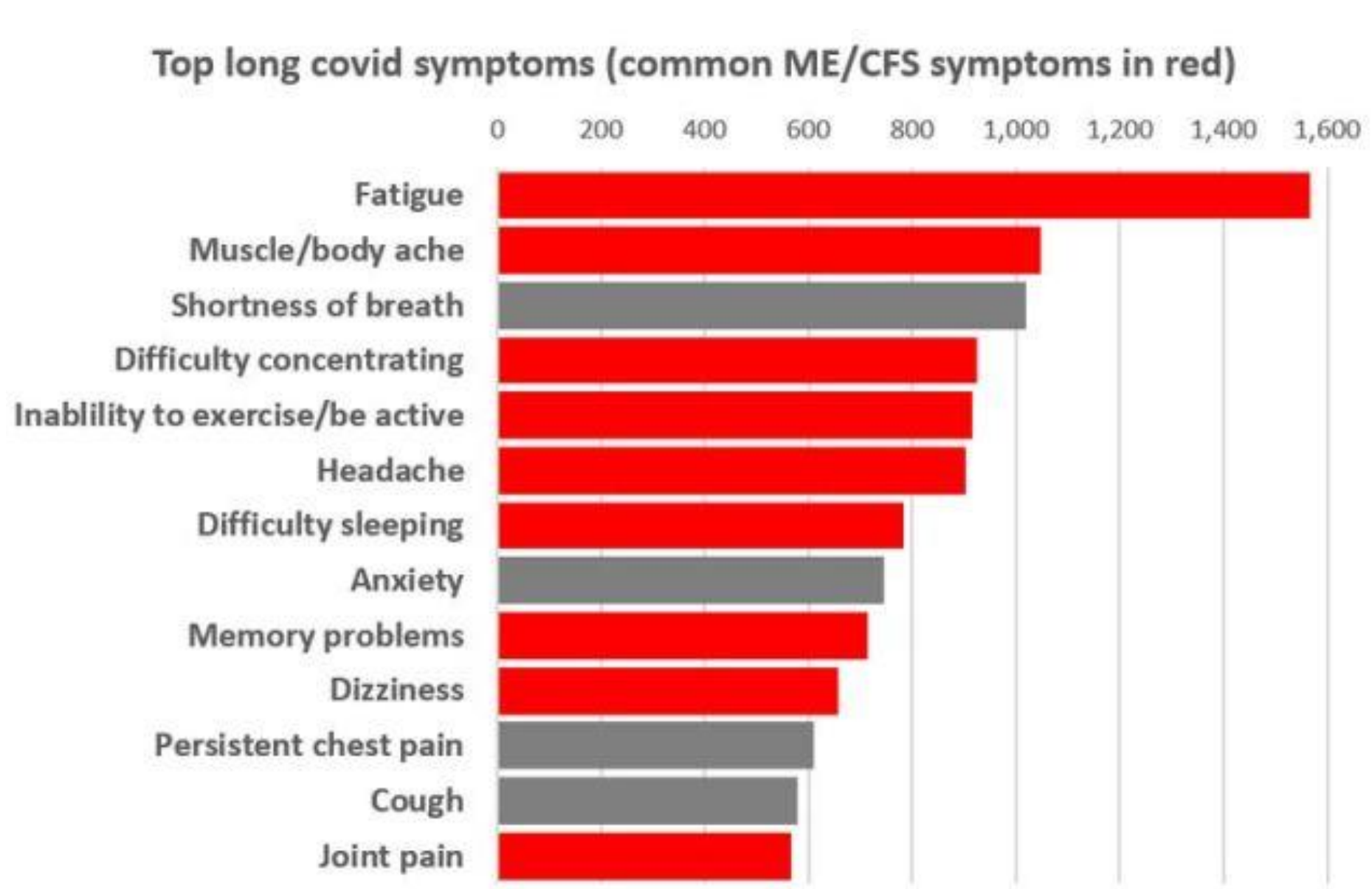
PVFS post COVID19 - symptoms

- https://patientresearchcovid19.com/research/report-1/#Demographics

- 89% symptoms fluctuate in nature

Top three symptoms:

- Shortness of breath
- Tightness of chest
- Fatigue



https://mecfsresearchreview.me/2020/09/17/understanding-long-covid-a-shortcut-to-solving-me-cfs/#symptoms

Fatigue

- Decreased mental and physical endurance
- Decreased motivation
- Depletion of reserves
- Lassitude (Krupp 2003)

Overwhelming sense of tiredness, weakness, lack of energy, and exhaustion (subjective fatigue);

or as a mismatch between expended effort and actual performance;

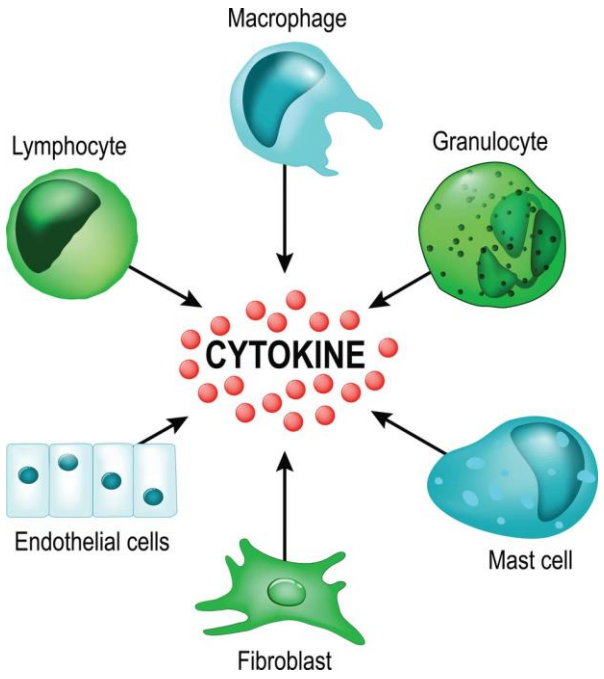
or as a reduction in the capacity to either initiate or sustain voluntary activities (objective fatigue)

(Kostic 2016)

Causes of fatigue from infections

- Increased cytokines (cell signaling) e.g. Interleukin-2 and interferon induce fatigue and T lymphocytes affect sleep.

(Krupp 2003)



PVFS/ME possible causes of fatigue:

Central

- CNS
- Endocrine dysfunction
- Immunological
- ANS

Peripheral

- Neuromuscular

Primary – related to pathology of the condition or
Secondary – related to other conditions such as sleep disturbances, depression etc

Other

- **Infections/Inflammation**
- **Respiratory**
- **Cardiac**
- Diet/digestive system disorders
- Lack of sleep
- Pain
- Lack of cardiovascular fitness
- Medications
- Neurological conditions
- Liver failure
- Kidney disease
- Hypothyroidism or other gland disorders
- Cancer
- Arthritis
- Anaemia, B12 deficiency
- Diabetes
- **The list goes on…**

PVFS/ME fatigue – central neurological causes:

- Evidence that COVID19 can invade the brain, cross the blood-brain barrier affecting glial cells and causing:
- encephalopathies, inflammatory CNS syndromes and strokes (Ahmed and Rathore 2020, Pellegrini et al 2020, Paterson et al 2020)

- Infection leads to long term activation of microglia – hyperalert state (https://www.youtube.com/watch?v=JW-JYCcAnUg&feature=youtu.be)
- Hypoxic brain injury (Ahmed and Rathore 2020)

PVFS/ME fatigue – central neurological causes:

- Reduction in brainstem perfusion.

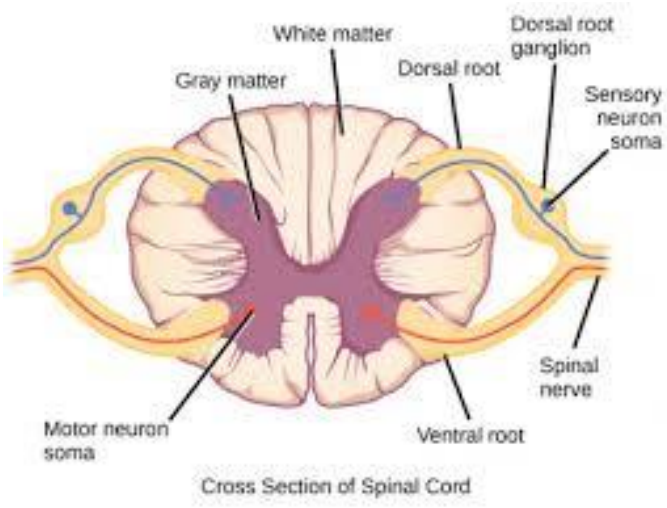
(Costa et al 1995)

- Reduced frontal lobe activity and deficits in perfusion and glucose uptake shown on PET scans.

(Krupp 2003)

PVFS/ME fatigue – central neurological causes:

- Brain scans - acidosis in brain. Damage to mitochondria – increased anaerobic metabolism (https://www.youtube.com/watch?v=bJ3UxSZ6MII&feature=youtu.be)



Exercise could make this worse

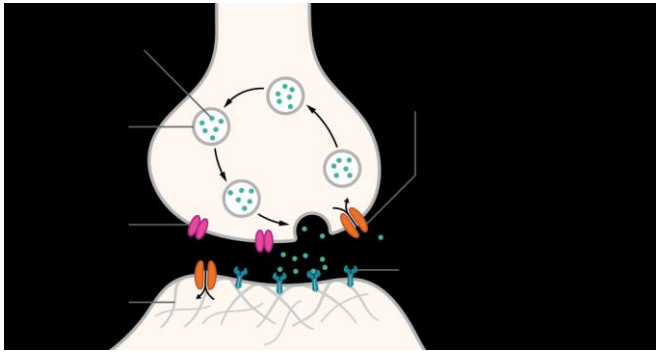
- Dorsal root ganglion neurons have been discovered that specifically respond to low pH, ATP and ammonia.

(Kluger et al 2013)

PVFS/ME fatigue – central neurological causes:

- Increased brain temperature, accumulation of ammonia, increases in serotonin, and decrements in dopamine

  (Kluger et al 2013)

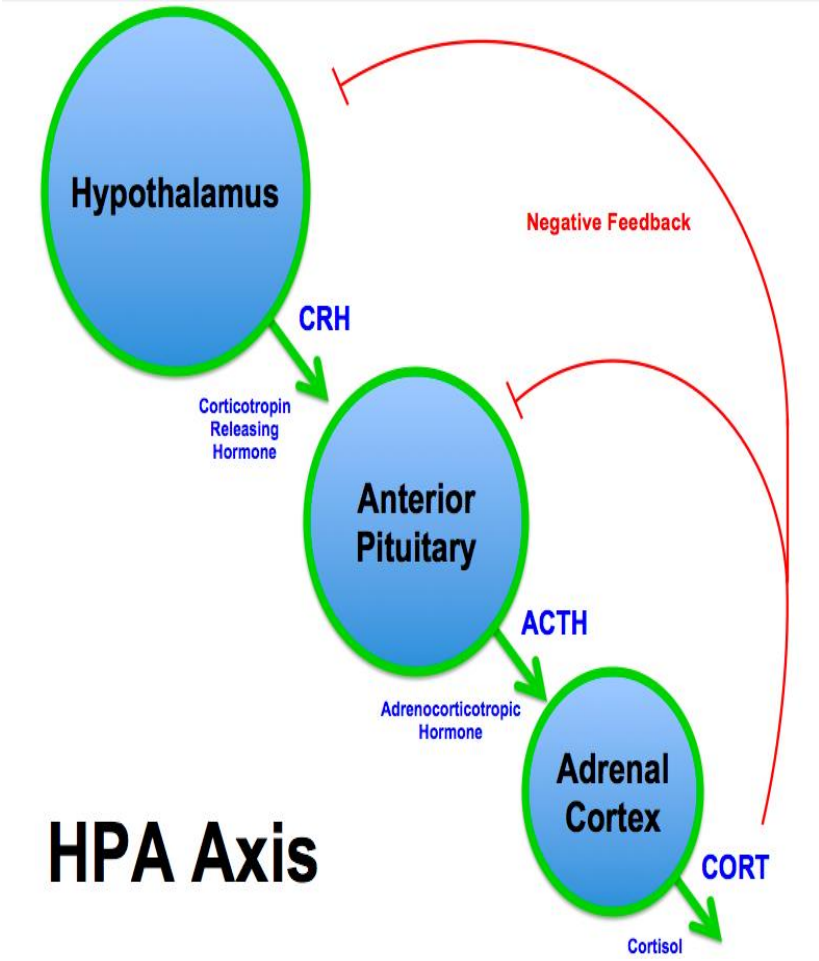


- Interaction between neurotransmitters and neuro endocrine system - dopamine and serotonin innervate the hypothalamus – and dopamine inhibits the anterior pituitary

  (Taylor et al 2016)

PVFS/ME fatigue – central neurological causes:

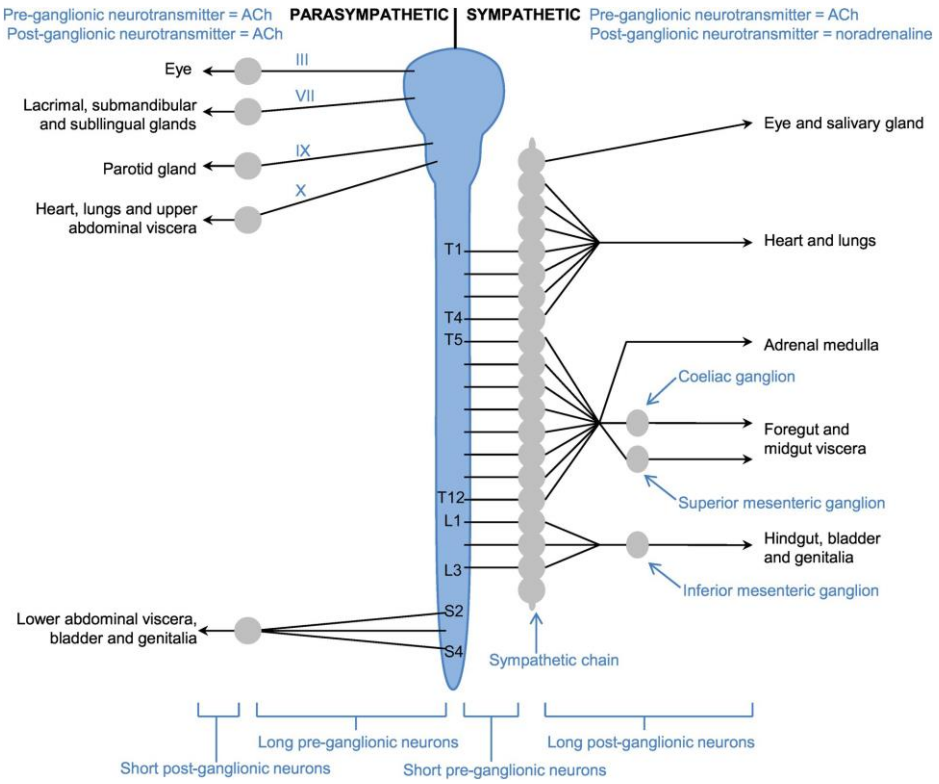
- Impact on sleep, temperature control, homeostasis
- Hypothalamic-pituitary-adrenal axis
- Normally stress leads to release of cortisol which reduces stress response.
- In abnormal systems – low levels of cortisol so highly sensitive to stress.



(Krupp 2003)

PVFS/ME fatigue – central neurological causes:

- Stress links with the Autonomic Nervous System which is also affected
- Reduced activity leads to fatigue due to effect of lowering BP, RR, HR. (Krupp 2003)
- Orthostatic intolerances – POTs, CI, NMH



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- Anaemia, B12 deficiency
- Diabetes
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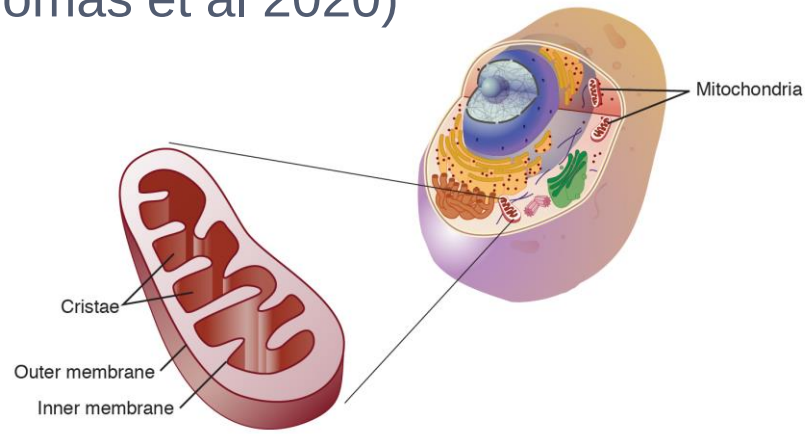
Peripheral - Neuromuscular causes

- Increased anaerobic metabolism, increased acidosis, reduced ATP production (Tomas et al 2020)
- Fall in muscle PCr, accumulation of H+ ions and reduced pH. (Krupp 2003)



Exercise will not help due to reduced ATP, increased anaerobic metabolism and increased lactic acid

Treatment of fatigue – medical management

Thorough medical assessment to rule out other conditions:

- **Routine laboratory investigation**: □ CBC, □ ESR, □ CA, □ P, □ RBC Mg, □ vitamin D3, □ B12 & folate, □ ferritin, □ zinc □ FBS, □ PC, □ Hb A1C, □ serum electrolytes, □ TSH, □ protein electrophoresis screen, □ CRP, □ creatinine, □ ECG (U+ T wave notching), □ CPK and liver function, □ rheumatoid factor, □ antinuclear antibodies, □ urinalysis, □ essential fatty acids, □ CoEnzyme Q10, □ immunoglobulins, □ diurnal cortisol levels, □ TTG, □ serotonin
- **Additional laboratory investigation**: (as indicated by symptoms, history, clinical evaluation, lab findings, risk factors)□ 24 hour urine free cortisol, □ DHEA sulphate, □ ACTH, □ chest x-ray, □ hormones including free testosterone □ panoramic x-ray of dental roots, □ amino acid profile, □ abdominal ultra sound, □ lactose/fructose breath test.
- **Pathogen Tests** (Carruthers and van de Sande 2011)

Treatment of fatigue – medical management

Thorough medical assessment to rule out other conditions:

- **Immune system profiles**: □ *↓NK cell function & ↑ cytotoxicity; □ B & T-cell function: □ IgG, □ IgG subclasses 1-4; □ IgA, □ IgM (shift from T1 to T2), □ cytokine/chemokine profile panel (94% accuracy): IL-8, IL-13, MIP-1β, MCP-1, IL4,□ flow cytometry for ↑ lymphocyte activity, □ ↑ 37 kDa 2-5A RNase L immunoassay – defect/ratio & bioactivity, □food sensitivity panel, □ chemical sensitivities, □ stool for WCB - D-lactic acid bacteria balance, ova & parasites, □autoimmune profile, Intestinal dysbiosis: □ IgA & IgM for intestinal aerobic bacteria in serum, □↑ leukocyte elastase activity in PBMCs, □ IgG food intolerance test, □ toxoplasmosis
- **Neurological & static testing**: □ *SPECT scan with contrast - ↓ cortical/cerebellar region cerebral blood flow (rCBF) in the frontal, parietal, temporal and occipital & brain stem regions □ MRI of spine (dynamic disc bulges/herniation , stenosis), □ sleep study (↓ stage 4 sleep, sleep pattern &rule out treatable sleep dysfunctions – upper airway resistance syndrome, sleep apnea, etc.)

Treatment of fatigue – medical management

Thorough medical assessment to rule out other conditions:

- **Energy metabolism/ion transport**: □ ATP profile – identifies insufficient energy due to cellular respiration dysfunction □ further ATP related parameters, superoxide dismutase and cell-free DNA Respiratory: □ pulmonary function test Cardiovascular: □ Tilt table test to confirm OI (70 -80% tilt, measure HR continuously, BP periodically – 30 min or presyncope); □ Cardiac output decreases - left ventricular dysfunction in the heart; □ 24-Hour Monitor for suspected arrhythmia, NMH/POTS, myocarditis

(Carruthers and van de Sande 2011)

- Be aware of the importance of differential diagnosis of fatigue

Comparison of symptoms between "Post Viral Fatigue post COVID19", Post Viral Fatigue Syndrome and Myalgic Encephalomyelitis

PVF (COVID*)	PVFS (+ 1 month**)	ME (+ 4 months**) (ICC Criteria)
Decreased exercise tolerance /fatigue	Activity induced fatigue (physical and mental)	A. Post exertional malaise (PEM) or Post-Exertional Neuroimmune Exhaustion (PENE): Physical and/or cognitive fatigability in response to exertion. Substantial reduction in pre-illness activity level. Post-exertional symptom exacerbation - recurring flare of viral symptoms. Recovery period is prolonged.
Decreased function/work/ADLs	Unable to maintain previous levels of activity	B. Neurological impairments: neurocognitive, pain, sleep disturbances, neuro sensory/perceptual/motor disturbances
Breathlessness or silent hypoxia	Intermittent and recurring flare of viral symptoms	C. Immune, Gastro-intestinal & Genitourinary Impairments: eg. flu like symptoms, sensitivities etc
Cognitive issues (memory, attention)	Unrefreshing sleep	D. Energy Metabolism/Ion Transportation Impairments: Cardiovascular - (OI), neurally mediated hypotension (NMH), postural orthostatic tachycardia syndrome (POTS), Resp or thermostatic
Swallow issues	Cognitive problems	
Muscle weakness & pain	Orthostatic intolerances	

* This is an evolving picture as more information is gathered. Covid is still new and not fully understood

**Timescales based on usual standards. Covid long-term behaviour still undefined

PEM – Hallmark feature of ME

Aka PENE (post exertional neuroimmune exhaustion)

International consensus primer describes PEM as:

1. Marked, rapid physical or cognitive fatigability in response to exertion
2. Post-exertional symptom exacerbation
3. Post –exertional exhaustion: immediate or delayed
4. Recovery period is prolonged
5. Low threshold of physical and mental fatigability (lack of stamina) results in a substantial reduction in pre-illness activity level

PEM – not just fatigue in ME

- Fatigue
- Poor concentration
- Difficulty thinking
- Muscle pain
- Sleep disturbance
- Poor memory
- Flu-like symptoms
- Joint pain
- Headache
- Sore throat
- Tender lymph nodes

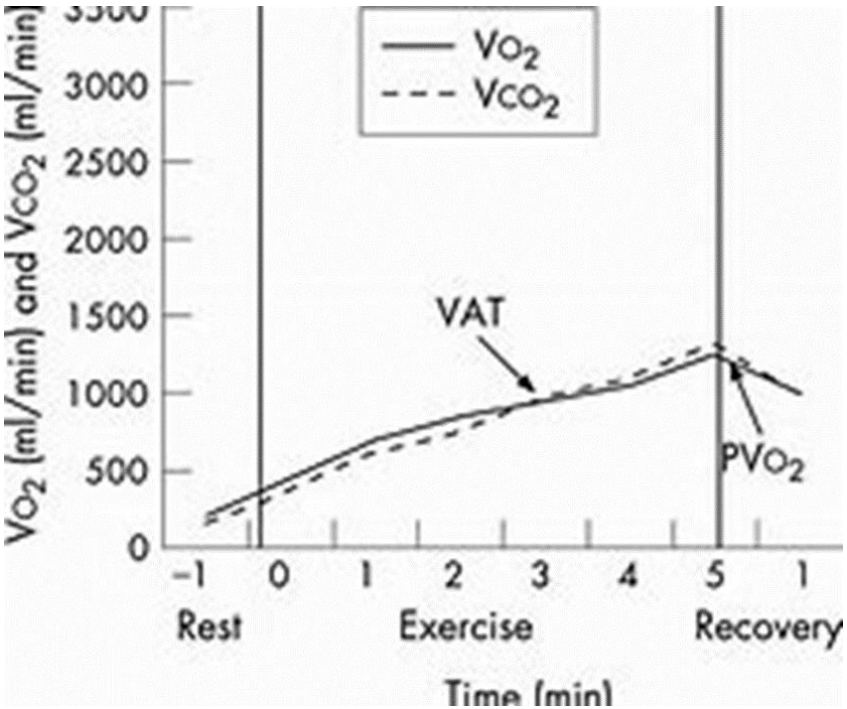
Delayed onset – up to 24 to 72 hours after exertion

Can persist for days, weeks, months, or years.

(Chu et al 2018)

PEM - CPET

- Amount of oxygen consumed and CO_2 produced is measured
- VO_2 max is when the patient can no longer push themselves due to fatigue
- Aiming to reach anaerobic threshold when amount of oxygen taken in is equal to the amount of CO_2 produced
- Switching to anaerobic respiration. Point at which lactic acid production increases.



CPET

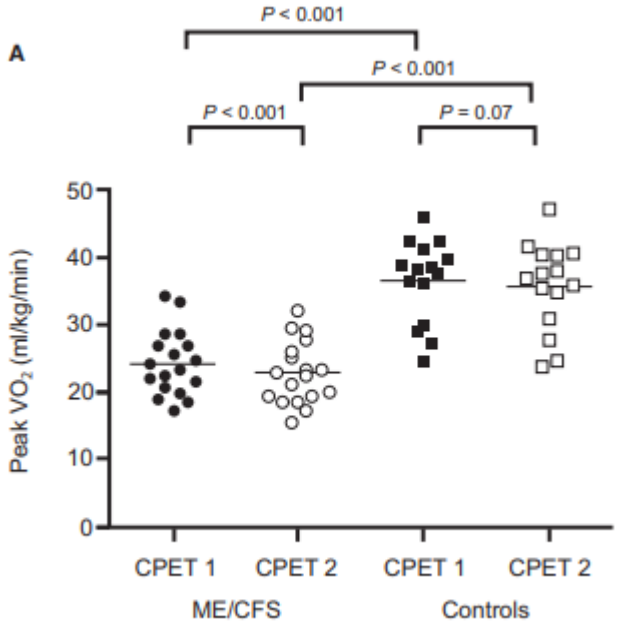
2 day Cardiopulmonary (CPET) test – @4WorkWell

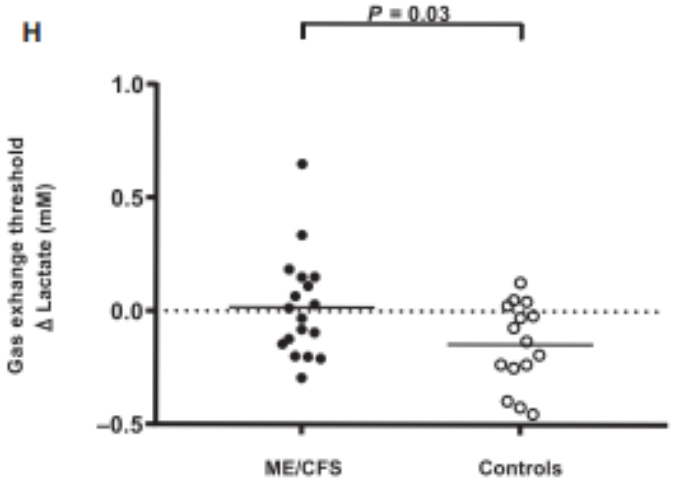
- https://www.healthrising.org/blog/2019/01/17/decoding-2-day-cpet-chronic-fatigue-syndrome/

2 day CPET test for pwme

- On all tests all pwme had lower VO_2 peak

On the second tests all pwme had higher levels of lactic acid production





Could this explain PEM?

(Lien et al 2019)

Does your post-Covid-19 patient have symptoms of Post Viral Fatigue Syndrome?

- ❑ Activity induced fatigue (physical and mental)
- ❑ Intermittent and recurring flare of viral symptoms
- ❑ Unable to maintain previous levels of activity
- ❑ Unrefreshing sleep
- ❑ Cognitive problems
- ❑ Orthostatic intolerances

! Consider Post Viral Fatigue Syndrome (PVFS)

⚠ Standard rehabilitation may be detrimental

Visit www.physiosforme.com for more info

Key management techniques for patients with Post Viral Fatigue Syndrome

- ❑ Rest and convalescence (not ‘pushing through’)
- ❑ Pacing (for both cognitive and physical activities)
- ❑ Aim to avoid symptoms and conserve energy
- ❑ Prioritise nutrition
- ❑ Prioritise sleep management

PVFS can progress into Myalgic Encephalomyelitis (“M.E.” or “Chronic Fatigue Syndrome”)

Physiotherapists should practice CPD around appropriate management of M.E.

Standard rehabilitation may be detrimental

Visit www.physiosforme.com for more info

Nonmedical management of fatigue –

Physio objective assessment

Thorough neuromuscular, cardiorespiratory assessment to determine potential contributors to fatigue:

- Strength
- Tone
- Sensation
- Coordination
- Pain
- BP/HR/RR/O_2 sats

Subjective assessment add questions on:

Pain

Rest and relaxation

Sleep

Diet

Mental health

Leisure time

Cognitive activities

Physical Activity

*******Activity and PEM****** Delayed onset**

Subjective - examples

- Relapsing/remitting pattern – ‘boom bust cycle’
- Not able to sustain everyday activities e.g. resting at weekends to recover from the week
- Responding well (symptom reduction) to doing less/resting more
- Doing too much causes a flare or relapse

> “I can clearly see there are phases of good followed by phases of bad where I am forced to do less, this leads to a good phase and the cycle repeats…when I crash, I can’t find the energy to fuel my muscles at all” (LH)

> “Five weeks ago, I started doing 10-15minute walks every evening, I got worse, slower and was shuffling” (JH)

> “I walked to the end of the road and back, 10 houses there and back with a rest, I ended up 3 days lying down, couldn’t cook or clean” (JFW)

> “Resting for short periods in the day has been a revelation” (KCS)

Measurement of fatigue (over 50 scales)

- Fatigue Severity Scale (MS, SLE)
- Fatigue Impact Scale (MS, CFS)
- FACIT (Fatigue Scale) (Chronic illness)
- Multidimensional Fatigue Symptom Inventory (cancer)
- Brief fatigue Inventory (cancer)
- Fatigue Assessment Scale (workers)
- Neurological fatigue index-MS (NFI-MS) in stroke
- Fatigue Descriptive Scale
- Visual Analogue scale for fatigue
- And many more

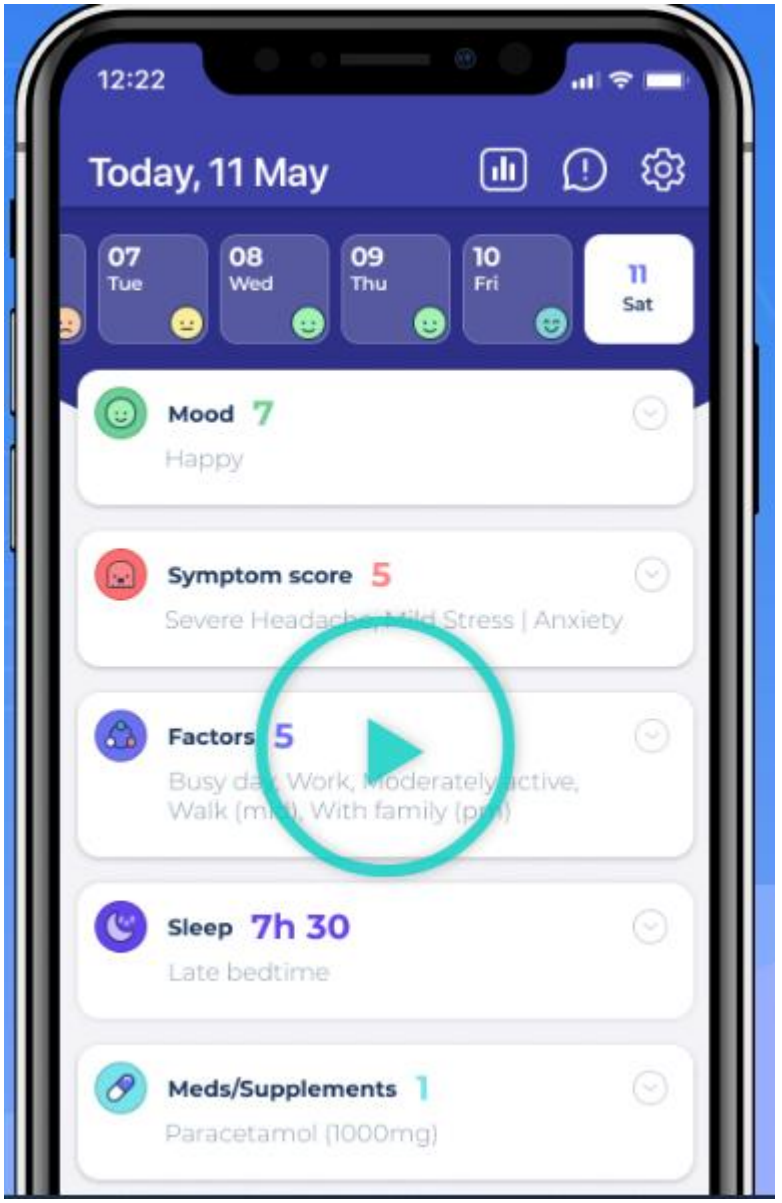
Activity/Rest (& symptom) diary

Weekly Diary

Week Starting:

	Sunday	Monday	Tuesday	Wednesday	Thursday	Friday	Saturday
7	(Sleep)	Breakfast	Breakfast	Breakfast	Breakfast	Breakfast	(Sleep)
8	(Sleep)	Chores	Shopping	Chores	Chores	Computer	(Sleep)
9	Breakfast	Phone	Phone	Phone	Phone	Rest	Breakfast
10	Computer	Computer	Computer	Computer	Computer	Rest	Laundry
11	Rest	Rest	Rest	Rest	Rest	Doctor	Rest
Noon	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch	Lunch
1	Visit friends	Work	Work	Work	Work	Chores	Phone
2	Friends	Work	Work	Work	Work	Computer	Shopping
3	Computer	Work	Work	Work	Work	Rest	Rest
4	Phone	Work	Work	Work	Work	Rest	Housecleaning
5	Rest	Rest	Rest	Rest	Rest	Phone	Rest
6	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner	Dinner out
7	Call parents	Computer	Computer	Computer	Rest	Computer	Dinner out
8	TV	Walk, TV	Walk, TV	Walk, TV	Walk, TV	TV	Rest
9	TV	TV	TV	TV	TV	TV	TV
10	Bath & Bed	Bath & Bed	Bath & Bed	Bath & Bed	Bath & Bed	Bath & Bed	Bath & Bed (11 pm)

Bearable app



How to pace, plan, prioritise:

1. Establish a baseline i.e. record activity and symptoms over 2 weeks

2. Remember this is **physical** and **cognitive** activity – then being able to recognize any activities that are particularly fatiguing/causing PEM

3. Regular small rests throughout the day – RESTORATIVE REST

4. Change activities – cognitive to physical

5. Break down activities – cleaning – get cleaning things out, wipe sink…

How to pace, plan, prioritise:

6. Energy conservation –

Think body positions, use aids – electric toothbrush, wheeled shopper and

appliances – wheelchairs, office chairs with wheels and brakes, shower seats.

7. Timers - can help to prevent over exertion

8. Prioritise – what needs to be done rather than what could be done

9. Plan – what activities are you going to do, what will you

needhttp://www.cfsselfhelp.org/library/how-i-use-pacing-manage-cfs

RCOT advice for post viral fatigue

How to manage post-viral fatigue after COVID-19

Practical advice for people who have been treated in hospital

Post-viral fatigue is when you have an extended period of feeling unwell and fatigued after a viral infection.

Fatigue is a normal part of the body's response to fighting a viral infection such as COVID-19, it's also common after any serious or critical illness that requires being admitted to hospital. Fatigue is likely to continue for some time after the infection has cleared. It can make you sleep more, feel unsteady on your feet, make standing for long periods difficult, as well as affecting your ability to concentrate and your memory.

How to conserve your energy

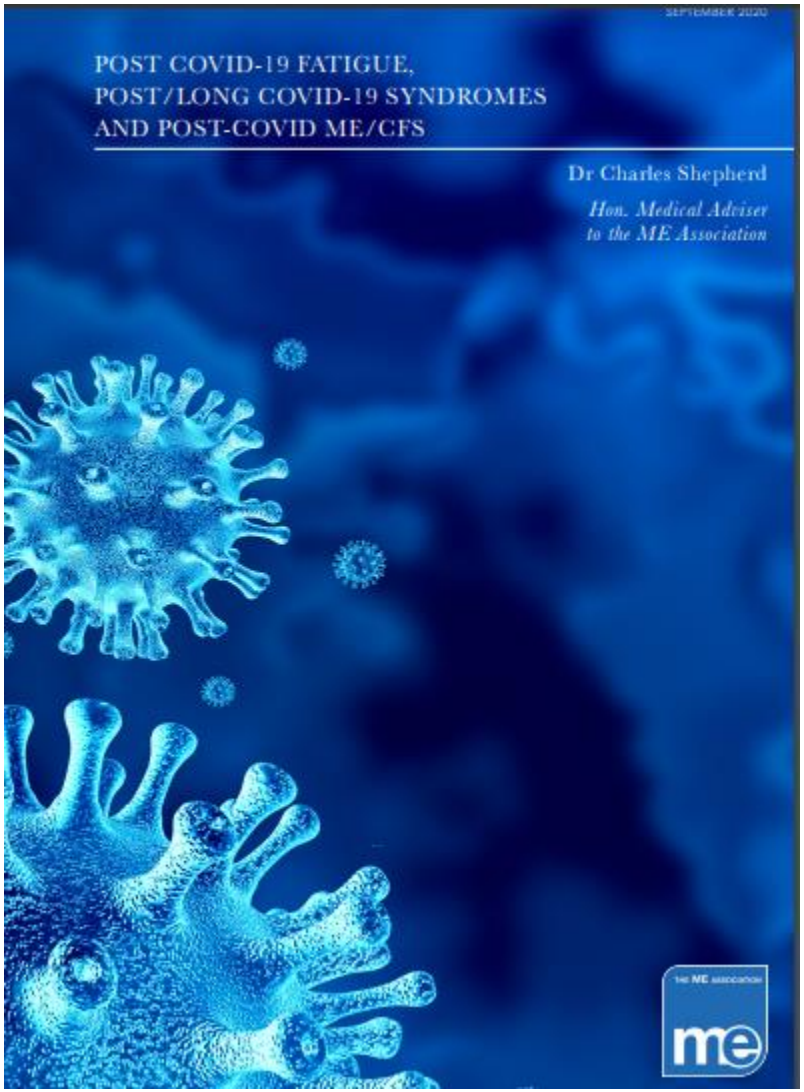
Practical advice for people during and after having COVID-19

When you are ill or recovering from an illness, you are likely to have less energy and feel tired. A simple task, such as putting on your shoes, can feel like hard work. This guide will help you to find ways to conserve your energy as you go about your daily tasks. By making these small changes you'll have more energy throughout the day.

The 3 Ps principle (Pace, Plan and Prioritise)

Learning to pace, plan and prioritise your daily activities will help you to save energy.

ME Association advice for post viral fatigue



https://meassociation.org.uk/wp-content/uploads/Post-Covid-Fatigue-Syndrome-and-MECFS-September-2020.pdf

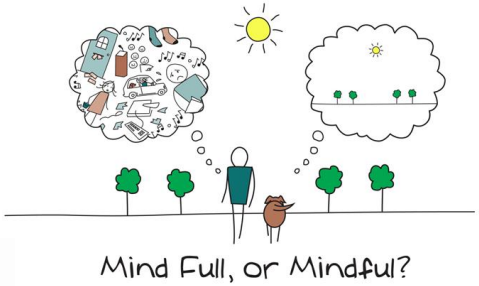
Energy Budget/Bank

- Pacing is not a cure but it is essential as it enables patients to make the best use of their limited energy.
- Similar to a household budget, the more limited the patient's energy, the more important it is to prioritize energy needs and budget its use.
- Ideally patients should work towards having four energy accounts.

EBB Accounts	Description
ADL	First priority is to conserve energy for the essential activities of daily living.
Emergency	Conserve some energy for unexpected events that require additional energy.
Sharing	Budget some time to share with others, whether by phone, email or in person. Talking and listening can be exhausting so these periods should be kept very short, with rest periods before and after. Prioritizing is essential.
Energy Savings Investment	Ideally, work towards saving a little energy every day in order to get stronger and invest in their future health.

General fatigue management

- 3Ps – Pace, Prioritise and Plan
- Rest and relaxation
- Sleep
- Food and nutrition
- Emotional health
- Cognition
- Leisure time
- Pain management
- Activity management
- HR monitoring



What about ‘rehab’?

- If a patient already has a limited energy budget/bank, adding in any aerobic/structured exercise may push the bank into deficit
- This could lead to a set-back/flare/relapse
- We know from people with ME that exercise can result in a longer-term reduction in health – sometimes for the rest of their lives
- However, there is a time and a place for ‘rehab’, but it can be a slow process, with careful monitoring of symptoms
- Patient DG: Long-covid, 8 months post infection, functioning at 20-30% pre-covid levels, has PEM
  - Walks 5 minutes in the morning and afternoon, below anaerobic threshold
  - 3 x 20minutes of cognitive activity per day
  - Started on gentle stretches in supine position for last 2 months
  - Patient stabilised symptoms with no flares
  - Started 4 x reps isometric muscle contractions with 1 minute rest in between each exercise for last 1 month

Patient A (an OT with long-covid)

- “In June/July, I was referred to pulmonary rehab physios. After being advised I should do something each day, no matter how I felt or I risk becoming deconditioned, I overdid it several times and had an awful prolonged experience of PEM”

- Patient has now been pacing, maintaining her baseline of activity and slowly increasing that every 2 weeks and is now hoping to start a new job on a phased return to work

Main advice for PVFS and ME

- Rest
- Pace
- Prioritise
- Plan
- HR monitoring
- Hydration
- Nutrition
- Sleep

Not GET (NICE statement), not aerobic exercise

NICE (2020) Draft

Do not offer people with ME/CFS:

- any therapy based on physical activity or exercise as a treatment or cure for ME/CFS
- generalised physical activity or exercise programmes – this includes programmes developed for healthy people or people with other illnesses
- any programme based on fixed incremental increases in physical activity or exercise, for example graded exercise therapy, structured activity or exercise programmes that are based on deconditioning as the cause of ME/CFS

HR monitoring

- http://livewithcfs.blogspot.com/2011/02/heart-rate-and-post-exertional-crashes.html

PhysiosforME podcasts –

- https://www.youtube.com/watch?v=1czIhtH9rjM&t=72s
- https://www.youtube.com/watch?v=Pa9vuik4iF4&t=483s

- People with ME have a lower anaerobic threshold ie. they move into anaerobic respiration a lot quicker than healthy individuals.
- Therefore they need to calculate their anaerobic threshold at 50% of their MHR
- (220 - your age) * 0.5 = anaerobic threshold or AT, in beats per minute
- HR monitoring aims to keep any activity below this threshold

Summary

- 4 types of long covid
- Long covid could be up to 10% of covid popn. ie. up to 5m worldwide and 60,000 in UK and still counting
- Fatigue is one of the main symptoms in long covid19/PVFS
- Potential causes relate to cardiorespiratory, central or peripheral damage
- Management of fatigue includes: comprehensive assessment, pacing, rest and relaxation, sleep management, food and nutrition and HR monitoring
- GET is not appropriate for **PVFS and ME due to central and peripheral damage**

Contact details

- @physiosforme
- www.physiosforme.com
- physiotherapyforme@gmail.com

HEE e-learning module

- https://www.e-lfh.org.uk/programmes/covid-19-recovery-and-rehabilitation/

COVID19 and ME Podcasts and films

HR monitoring:

- https://www.youtube.com/watch?v=1czIhtH9rjM&t=72s
- https://www.youtube.com/watch?v=Pa9vuik4iF4&t=483s

PVF, PVFS and ME

- https://www.youtube.com/watch?v=OyFNVayKYCg&feature=youtu.be

Films

- Unrest
- Voices from the shadows

COVID19 articles

- https://www.bmj.com/content/370/bmj.m3026/rr-8?utm_source=twitter&utm_medium=social&utm_term=hootsuite&utm_content=sme&utm_campaign=usage
- https://www.nzherald.co.nz/lifestyle/news/article.cfm?c_id=6&objectid=12353082
- https://jamanetwork.com/journals/jama/fullarticle/2768351?appId=scweb
- https://www.washingtonpost.com/health/covid-slow-recovery-long-hauler-complications--/2020/09/18/73c2fd20-f45c-11ea-bc45-e5d48ab44b9f_story.html?utm_campaign=wp_main&utm_medium=social&utm_source=twitter
- https://science.sciencemag.org/content/369/6510/1414
- https://www.medscape.com/viewarticle/937559?src=soc_tw_200919_mscpedt_news_mdscp_thrombosis&faf=1
- https://www.livescience.com/covid-long-haulers-updates.html
- https://www.rnz.co.nz/news/covid-19/426123/sick-and-tired-of-covid-19-the-recovered-patients-who-aren-t-getting-better
- https://www.theguardian.com/world/2020/sep/13/i-was-infected-with-coronavirus-in-march-six-months-on-im-still-unwell?CMP=Share_iOSApp_Other

COVID19 and ME videos

- https://www.facebook.com/watch/?v=129040682797415 8
- https://www.bbc.co.uk/news/av/uk-england-kent-54197288
- https://edition.cnn.com/2020/09/15/us/long-haul-coronavirus-father-son/index.html
- https://www.youtube.com/watch?v=yh53AnVNQqw&feature=youtu.be
- https://www.youtube.com/watch?v=UV9NHTONrJs&feature=youtu.be&fbclid=IwAR2pF7z44eeKHLGbotrOBgu3MPC6VSFAe7YWGN-9I8vpYm5nKnrC2Enzn-8
- https://www.youtube.com/watch?v=bJ3UxSZ6MII&feature=youtu.be
- https://www.youtube.com/watch?v=JW-JYCcAnUg&feature=youtu.be

Websites

www.wearebodypolitic.com

https//www.physiosforme.com

Shepherd, C., Dr. (2017) NHS Choices, YouTube – https://youtu.be/hLeDEgo6Pd0
Available from: https://www.nhs.uk/conditions/chronic-fatigue-syndrome-cfs/

http://livewithcfs.blogspot.com/2011/02/heart-rate-and-post-exertional-crashes.html

www.thegracecharityforme.org

http://www.shoutoutaboutme.com/about-me/7293/

https://www.healthrising.org/blog/2019/01/17/decoding-2-day-cpet-chronic-fatigue-syndrome/

https://alifehidden.com/2019/08/07/emilysappeal/amp/?__twitter_impression=true

https://www.meassociation.org.uk/2019/04/forward-me-and-oxford-brookes-university-announce-results-of-patient-survey-on-cbt-and-get-in-me-cfs-03-april-2019/

https://journals.sagepub.com/doi/abs/10.1177/1359105319847261

https://braininfectionsglobal.tghn.org/

Websites

https://www.facebook.com/notes/nz-carers-of-kids-with-mecfsrelated-illnesses/you-and-me-an-update-on-myalgic-encephalomyelitis-for-psychologists-by-rose-silv/210275105308663 7/

https://www.bbc.co.uk/news/uk-scotland-48770748#

https://www.youtube.com/watch?v=208JacsB5kM&feature=youtu.be

https://www.meaction.net/2019/07/24/uk-teenager-with-severe-me-threatened-with-forced-institutionalized/

www.thegracecharityforme.org

http://www.shoutoutaboutme.com/about-me/7293/

References

Ahmed and Rathore (2020) Neurological manifestations and complications of COVID-19: A Literature Review https://www.preprints.org/manuscript/202004.0453/v1

Bartels (2009) Fatigue in Cardiopulmonary disease. Phys Med Rehabil Clin N Am 20 (2009) 389–404

Carruthers BM, van de Sande MI, De Meirleir KL, Klimas DG, Broderick G, Mitchell T, Staines D, Powles ACP, Speight N, et al. (2011) Myalgic encephalomyelitis: International Consensus Criteria. J Intern Med; 270 pp. 327-338. Reprinted with permission of John Wiley & Sons. Some notes are slightly modified.
http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2796.2011.02428.x/full
http://onlinelibrary.wiley.com/doi/10.1111/j.1365-2796.2011.02428.x/pdf

Chaudhuri, A and Behan, PO (2000) Fatigue and basal ganglia, Journal of the Neurological Sciences 179(S 1-2) pp.34-42

Costa DC, Tannock C, Brostoff J. (1995) Brainstem perfusion is impaired in chronic fatigue syndrome. QJM; 88 pp. 767-773.

Couzin-Frankel, J. (2020) Viral heart damage under scrutiny. Science, 369, 6510, pp. 1414 - 1415

Dahl I (2018) Classic pacing for a better life with ME. Writersworld.

.

References

Docherty et al (2020) Features of 16,749 hospitalised UK patients with COVID-19 using the ISARIC WHO Clinical Characterisation Protocol. https://www.medrxiv.org/content/10.1101/2020.04.23.20076042v1

Gousmit EM, Nijs,J, Jason LA & Wallman, KE (2011) Pacing as a strategy to improve energy management in myalgic encephalomyelitis/chronic fatigue syndrome: a consensus document. Disability & Rehabilitation, 1–8, Early Online

Hasanpour-Dehkordi, Ali; Yadollahi, Mitra; Tali, Shahriar; Gheshlagh, Reza (2020) Effect of exercise training on dimensions of quality of life and fatigue in people with congestive heart failure class II and III: A randomized controlled trial. Indian Journal of Medical Specialities (INDIAN J MED SPECIALITIES), Jan-Mar2020; 11(1): 15-20.

Kapella MC, Larson JL, Patel MK, Covey MK, Berry JK. (2006) Subjective fatigue, influencing variables, and consequences in chronic obstructive pulmonary disease. Nursing Research, 55(1),pp.10-17.

Kluger,BM, Krupp, LB and Enoka, RM (2013) Fatigue and fatigability in neurologic illnesses. Proposal for a unified taxonomy. American Academy of Neurology. 80; pp. 409-416

Krupp, L.B. (2003) Fatigue (The most common complaints series). Butterworth-Heinemann

Kuppuswamy A (2017) The fatigue conundrum, Brain 140, pp. 2240–2245

References - Fatigue

Lacasse Y; Goldstein R; Lasserson TJ; Martin S (2015) Pulmonary rehabilitation for chronic obstructive pulmonary disease. Cochrane Database of Systematic Reviews (COCHRANE DATABASE SYST REV), (2): N.PAG-N.PAG.

Liu et al (2020)

Martinez et al (2020)

Paterson et al (2020) https://academic.oup.com/brain/article-abstract/doi/10.1093/brain/awaa240/5868408

Pellegrini et al (2020)

Puntmann et al (2020)

References - Fatigue

Taylor JL, Amann M, Duchateau,J, Meeusen, R and Rice, CL (2016) Neural Contributions to Muscle Fatigue: From the Brain to the Muscle and Back Again. Med Sci Sports Exerc. 48(11), pp. 2294–2306.

Togo,F, Natelson,BH, Cherniack,NS, FitzGibbons,J, Garcon C and Rapoport, D,M (2008) Sleep structure and sleepiness in chronic fatigue syndrome with or without coexisting fibromyalgia. Arthritis Research & Therapy, 10:R56

Tomas C, Elson JL, Strassheim V, Newton JL, Walker M (2020) The effect of myalgic encephalomyelitis/chronic fatigue syndrome (ME/ CFS) severity on cellular bioenergetic function. PLoS ONE 15(4): e0231136

References - ME

Carruthers, B. M. MD, CM, FRACP (C) & Van de Sande, M.I. B ed.(eds) (2012), International Consensus Primer For Medical Practitioners, International Consensus Panel, available from http://www.investinme.org/Documents/Guidelines/Myalgic%20Encephalomyelitis%20International%20Consensus%20Primer%20-2012-11-26.pdf

Chu, L, Valencia, IJ, Garvert, DW, Montoya, JG. (2018) Deconstructing post-exertional malaise in myalgic encephalomyelitis/ chronic fatigue syndrome: A patient-centered, cross-sectional survey. PLoS ONE 13(6): e0197811.

Cleare, A. J. et al (2015). Chronic Fatigue Syndrome, BMJ Clinical Evidence, 1101. Available from https://www.ncbi.nlm.nih.gov/pmc/articles/PMC4585442/

Davenport TE, Lehnen M, Stevens SR, VanNess JM, Stevens J and Snell CR (2019) Chronotropic Intolerance: An Overlooked Determinant of Symptoms and Activity Limitation in Myalgic Encephalomyelitis/Chronic Fatigue Syndrome? Front. Pediatr. 7, pp.82.

Jason, L. PhD, (2019) CDC Empirical Case Definition and Prevalence of CFS, International Association for Chronic Fatigue Syndrome and Myalgic Encephalomyelitis. Available from – http://iacfsme.org/ME-CFS-Primer-Education/Pages/CDC-Empirical-Case-Definition-and-Prevalence-of-CF.aspx

References - ME

Lien et al (2019) Abnormal blood lactate accumulation during repeated exercise testing in myalgic encephalomyelitis/chronic fatigue syndrome. Physiological reports. 7, 11, pp.1-14

M.E. Association, (2019) Seven Key Symptoms for Making a Diagnosis of ME/CFS. Available from https://www.meassociation.org.uk/about/the-symptoms-testing-assessment-mecfs/#Part%201

M.E. Association, (2019) Symptoms, Testing and Assessment https://www.meassociation.org.uk/about/the-symptoms-testing-assessment-mecfs/

M.E. Association (2017), Pace Trial – the making of a medical scandal, Press release: Journal of Health Psychology, Special Issue on The PACE Trial, Vol. 22, No 9, Aug. 2017. Available from https://www.meassociation.org.uk/2017/07/the-pace-trial-the-making-of-a-medical-scandal-29-july-2017/

M.E. Association (2011) Disability Scale (downloadable pdf) https://www.meassociation.org.uk/wp-content/uploads/2012/02/MEA-Disability-Rating-Scale.pdf

References - ME

Younger, J., (2018), The Open Medical Foundation, How brain inflammation causes ME/CFS, YouTube https://youtu.be/8XrdSlpUQTE

World Health Organisation (2016) G93.3 classification https://icd.who.int/browse10/2016/en#/G93.3 ICD: 10 version:2016