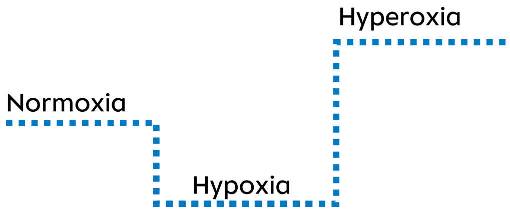
Institute of Medical Immunology

The Effects of Hyperbaric Oxygen Therapy (**HBOT**) in Patients with ME/CFS

Laura Kim | 13.05.2025 |
International ME/CFS Conference 2025

Hyperbaric Oxygen Therapy: Mechanisms and Implications for ME/CFS

Oxygenation States



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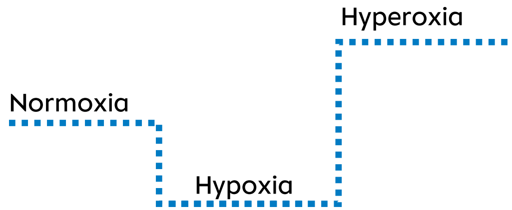

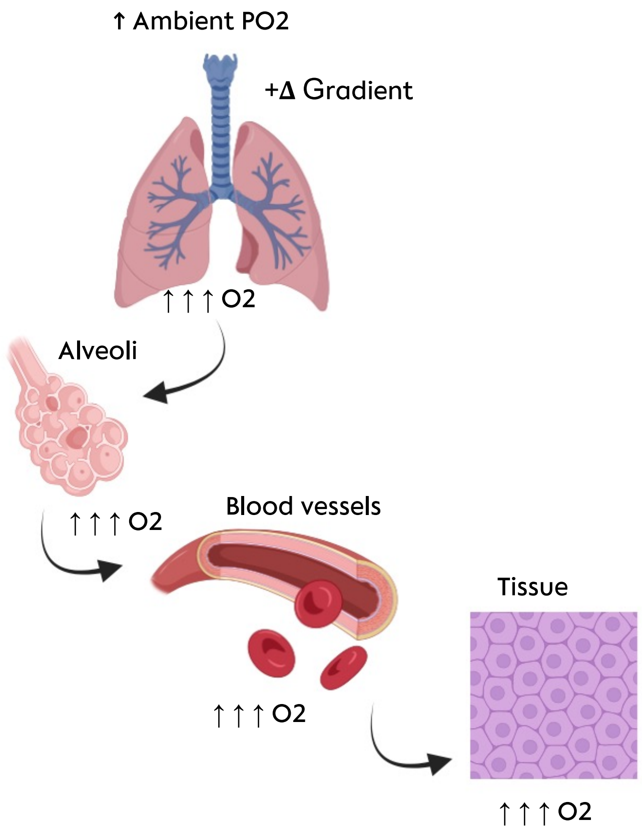

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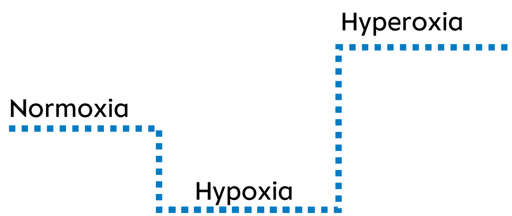
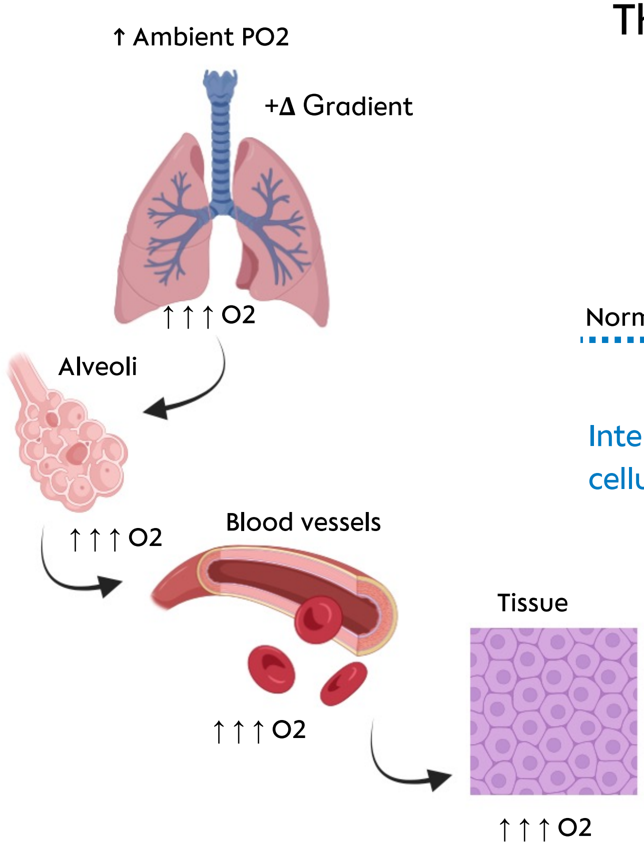
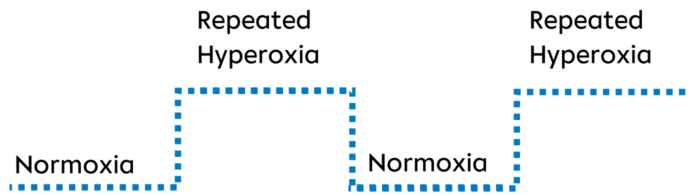




The „Hyperoxia-Hypoxia Paradox“



Intermittent hyperoxia triggers a hypoxia-like cellular response.

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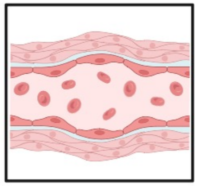
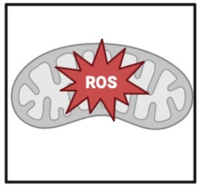
Activation of HIF-1a and related pathways:



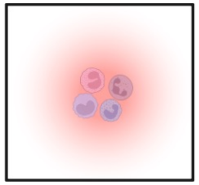
Elevated VEGF and angiogenesis

Hadanny A, Efrati S. The Hyperoxic-Hypoxic Paradox. Biomolecules. 2020 Jun 25;10(6):958. doi: 10.3390/biom10060958. PMID: 32630465; PMCID: PMC7355982.



Improved mitochondrial activity and decreased in ROS levels

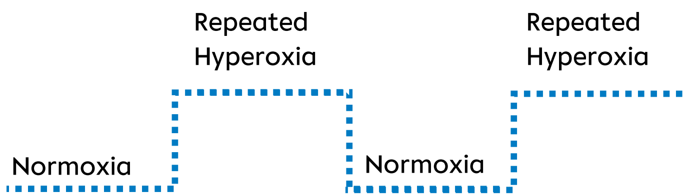
Schottlender N, Gottfried I, Ashery U. Hyperbaric Oxygen Treatment: Effects on Mitochondrial Function and Oxidative Stress. Biomolecules. 2021 Dec 3;11(12):1827. doi: 10.3390/biom11121827. PMID: 34944468; PMCID: PMC8699286.



Reduced inflammatory cytokines (IL-1, IL-6, TNF-α) and promoted anti-inflammatory profiles (e.g. IL-10, TGF-β)

Hedetoft M, Garred P, Madsen MB, Hyldegaard O. Hyperbaric oxygen treatment is associated with a decrease in cytokine levels in patients with necrotizing soft-tissue infection. Physiol Rep. 2021 Mar;9(6):e14757. doi: 10.14814/phy2.14757. PMID: 33719215; PMCID: PMC7957267.

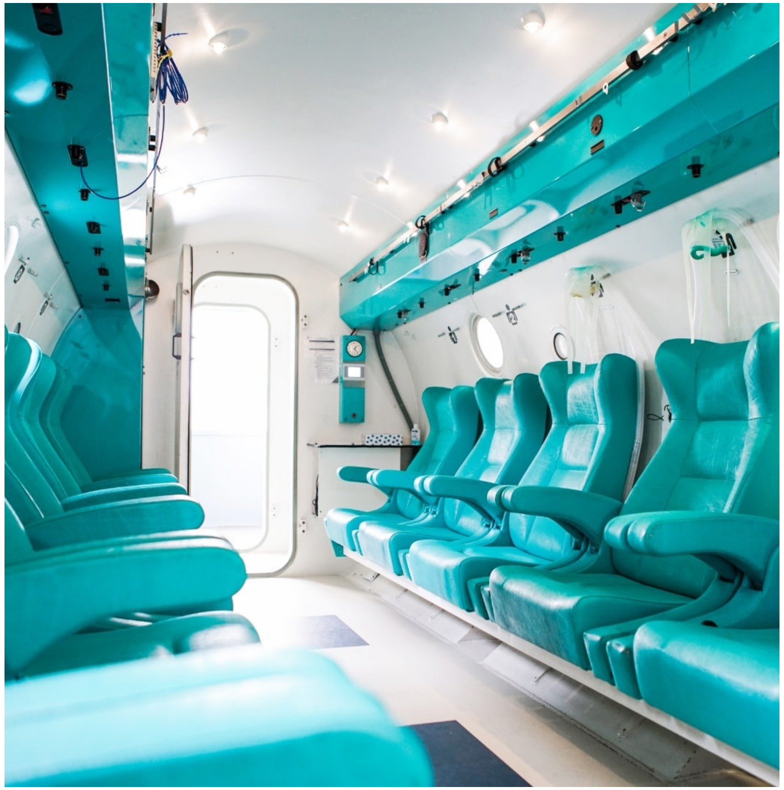
The „Hyperoxia-Hypoxia Paradox“



Intermittent hyperoxia triggers a hypoxia-like cellular response.

HBOT as a Therapeutic Option in Post-COVID and ME/CFS

- 1 RCT with 37 vs. 36 patients (Israel)
  - Improvement in **fatigue, pain and neurocognitive symptoms**
- 1 RCT with 40 vs. 40 patients ("HOT-LoCO", Sweden)
  - **no significant difference** between HBOT and placebo in physical functioning and physical health
- 10 smaller observational studies and case reports
  - Improvement in fatigue and "brain fog"
  - Improvement in respiratory and neurological symptoms
  - Favorable safety profile



Wu BQ, Liu DY, Shen TC, Lai YR, Yu TL, Hsu HL, Lee HM, Liao WC, Hsia TC. Effects of Hyperbaric Oxygen Therapy on Long COVID: A Systematic Review. Life (Basel). 2024 Mar 26;14(4):438. doi: 10.3390/life14040438. PMID: 38672710; PMCID: PMC11051078.

Kjellberg A, Hassler A, Boström E, El Gharbi S, Al-Ezerjawi S, Schening A, Fischer K, Kowalski JH, Rodriguez-Wallberg KA, Bruchfeld J, Ståhlberg M, Nygren-Bonnier M, Runold M, Lindholm P. Ten sessions of hyperbaric oxygen versus sham treatment in patients with long covid (HOT-LoCO): a randomised, placebo-controlled, double-blind, phase II trial. BMJ Open. 2025 Apr 14;15(4):e094386. doi: 10.1136/bmjopen-2024-094386. PMID: 40228859; PMCID: PMC11997836.

Study Protocol

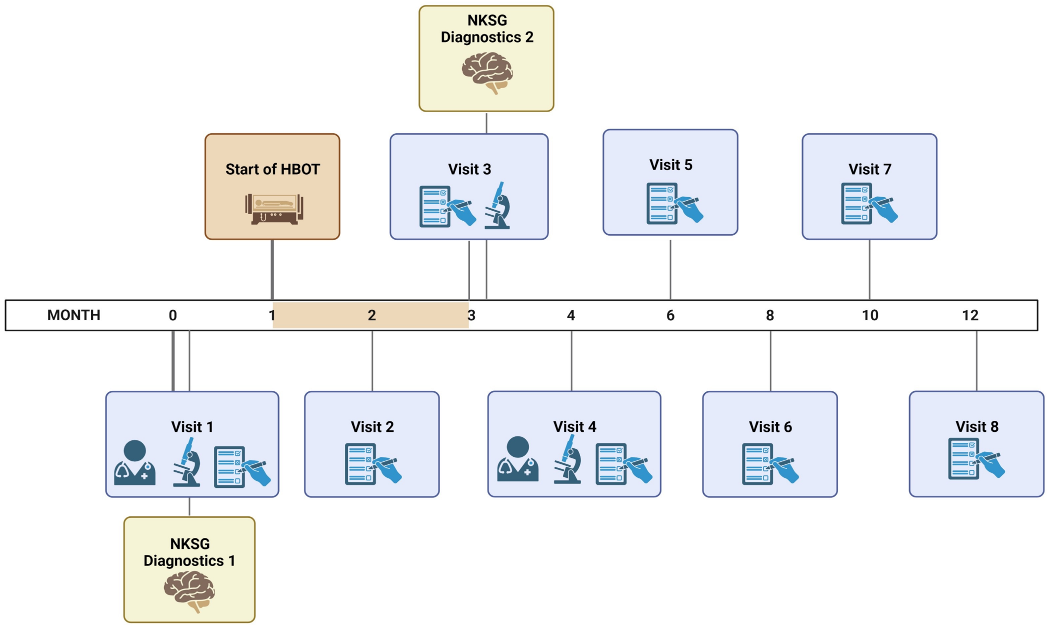
40 vs. 20 sessions of HBOT,
3–5 times per week, each lasting 90 minutes, 2 ATA, 100% oxygen, with breathing breaks every 20 minutes for 5 minutes

Outpatient Appointment
- Medical Consultation
- Hand Grip Strength Test
- 1 Minute Sit-to-Stand Test
- NASA Lean Test
- Neurocognitive Testing

Online Survey
- SF-36
- Bell Score
- MBSQ
- Chalder Fatigue Scale
- HBOT Tolerability Questionnaire

NKSG Diagnostics Platform
- MRI
- Endopat
- OCT-A

Laboratory Markers
- GPCR Autoantibodies
- Microclots
- Spike Protein
- Endothelial Function Biomarkers
- Proteomics
- SCS
- Flow Cytometry
- Cytokines and further soluble markers



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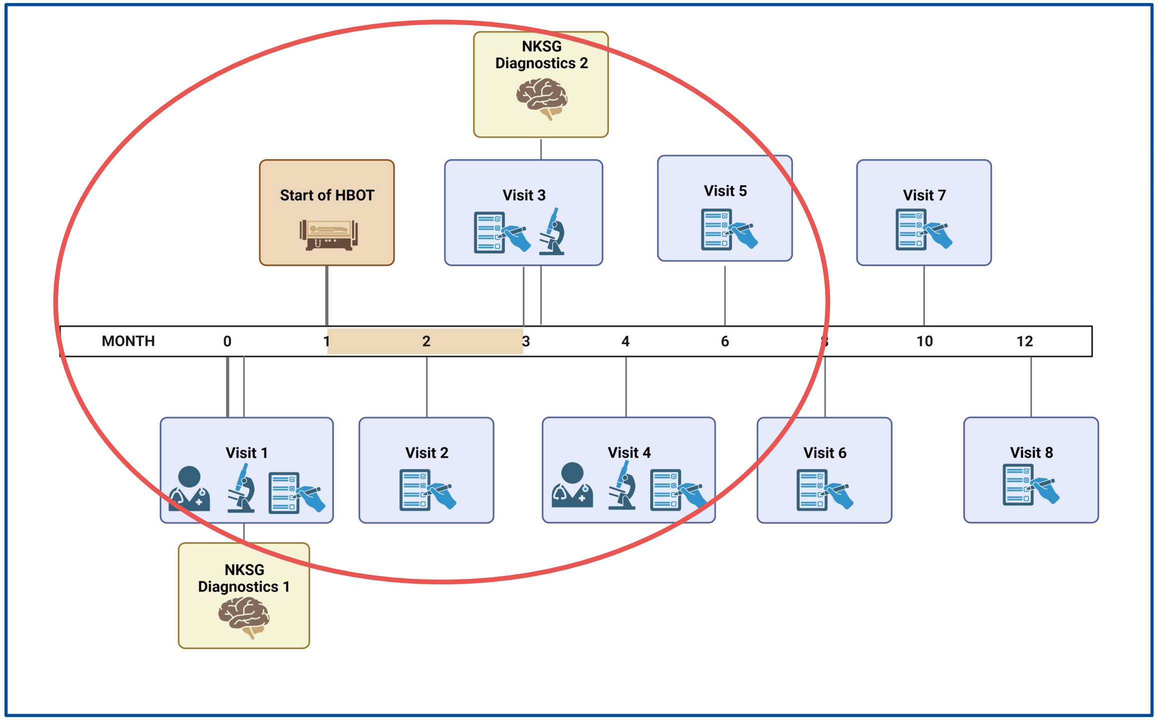


30 ME/CFS Patients Received 40 HBOT Sessions

Characteristics	
Total patients (n)	30
Male (n, %)	7 (23.33%)
Female (n, %)	23 (76.67%)
Age, years (mean ± SD)	42.33 ± 11.73
BMI, kg/m^2 (mean ± SD)	24.45 ± 4.04
Education level (n, %)	
No degree	0 (0%)
High School	4 (13.33%)
Vocational Training	10 (33.33%)
University degree	16 (53.33%)
Disease duration, months (mean ± SD)	**27.03 ± 11.21**
Infectious trigger (n, %)	30 (100%)
COVID-19	**27 (90%)**
EBV	1 (3.33%)
Upper respiratory tract infection	2 (6.67%)
Diagnostic criteria used (n, %)	
CCC	30 (100%)
IOM	30 (100%)
SF-36 PF score (mean ± SD)	**37.50 ± 20.63**
Bell Score (mean ± SD)	**38.00 ± 10.95**
Handgrip strength, kg (mean ± SD)	
Mean handgrip strength (Fmean)	15.82 ± 11.03
Maximum handgrip strength (Fmax)	19.02 ± 12.02

Patients were persistently ill.

SARS-CoV-2 infection was the most common disease trigger, the remaining patients had other viral triggers.

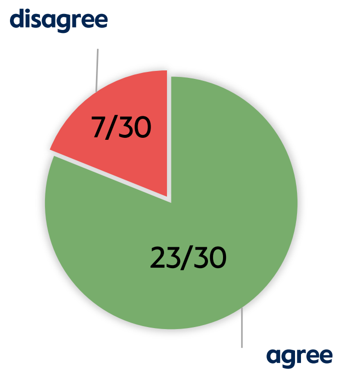
All patients had a severe to moderate degree of disability.

Treatment Course and Side Effects

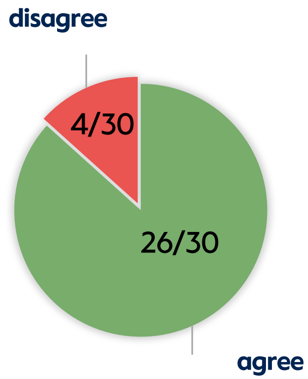
Side Effects

- Feeling of pressure or mild ear pain (n = 13, 43.33 %)
- Reversible myopia (n = 17, 56.67%).
- No severe or permanent side effects
- No patient discontinued treatment due to PEM or worsening ME/CFS symptoms.

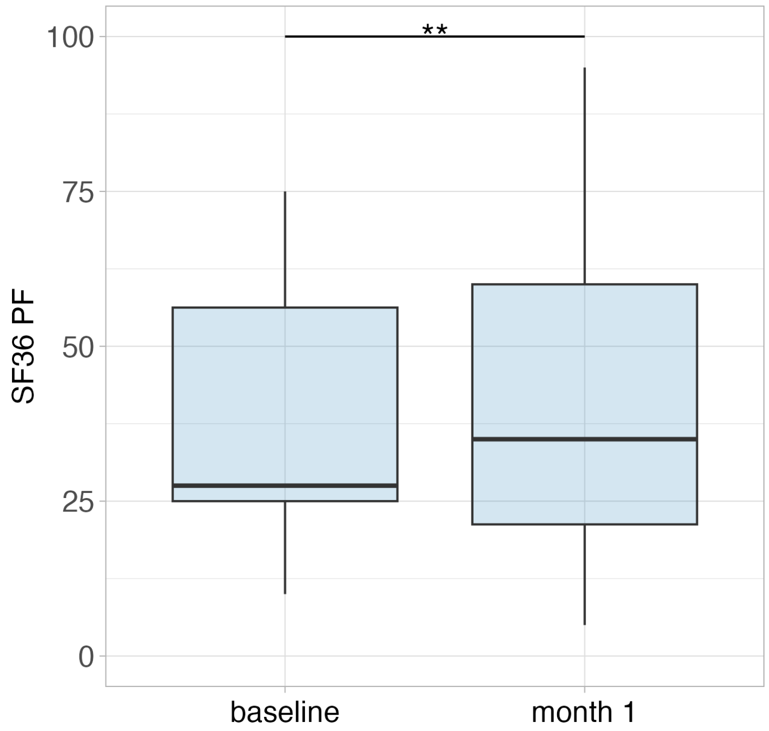
"My condition related to the illness has improved through hyperbaric oxygen therapy."



"I would participate in another hyperbaric oxygen therapy at a later time."



Main Outcome – Response in the SF36 Physical Fuctioning



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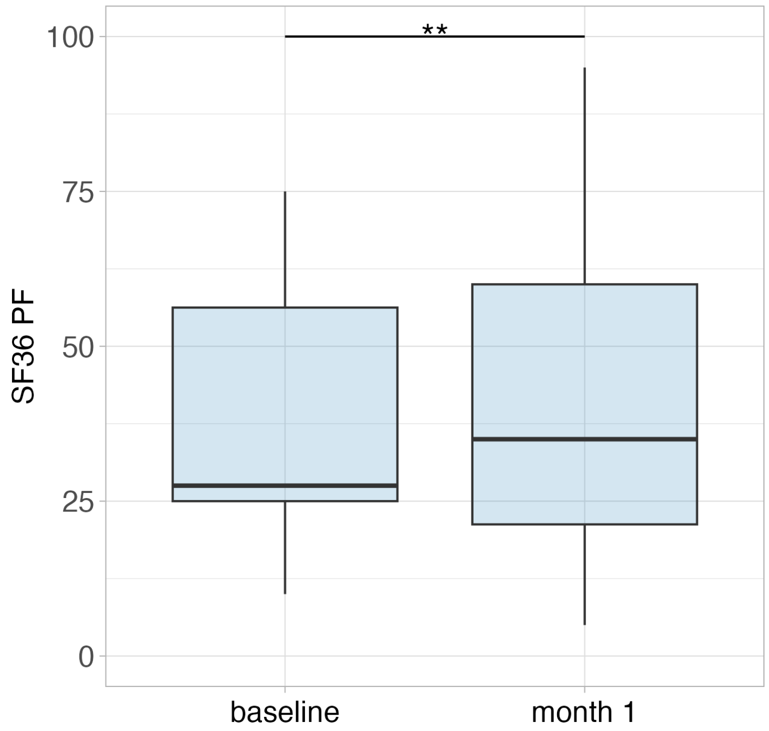
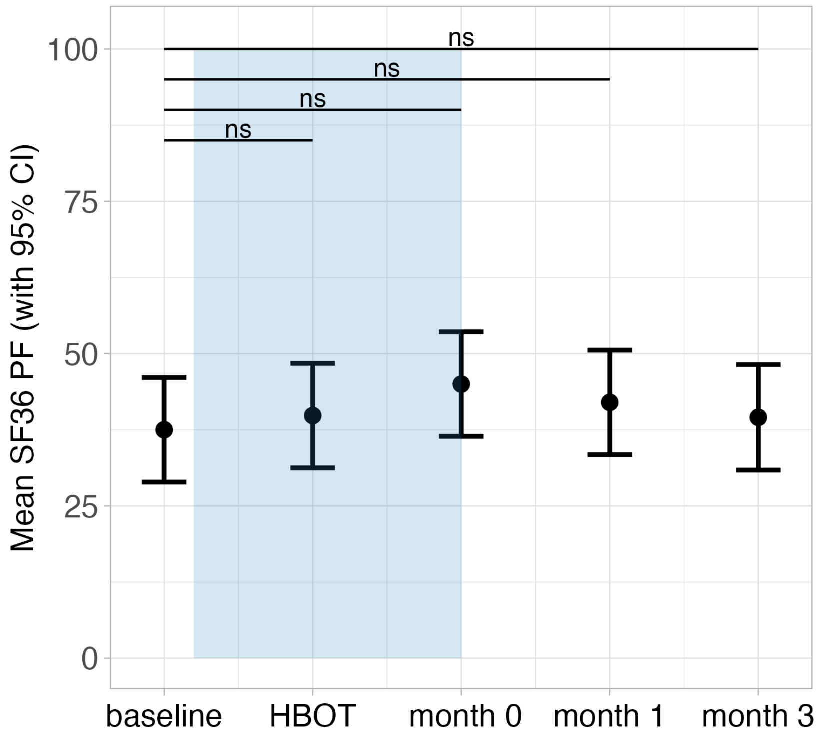
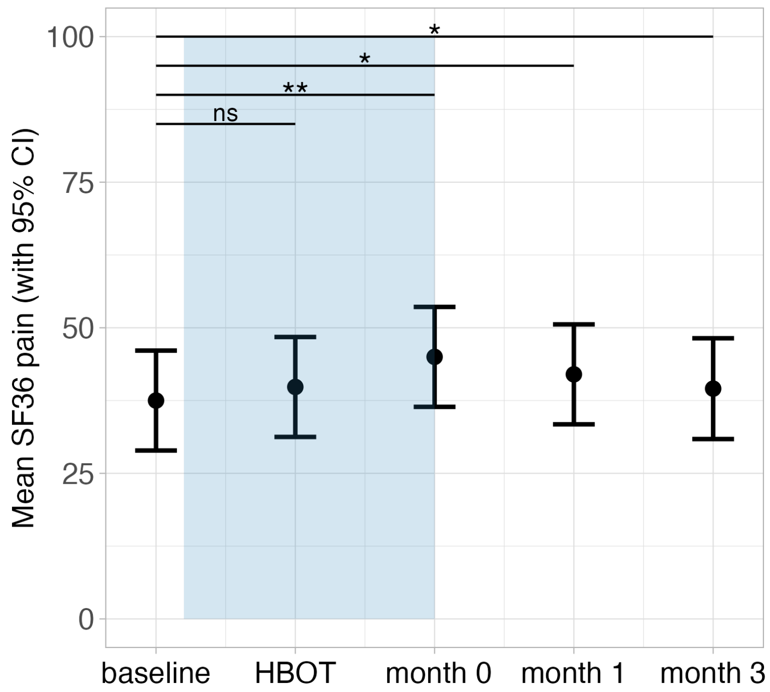


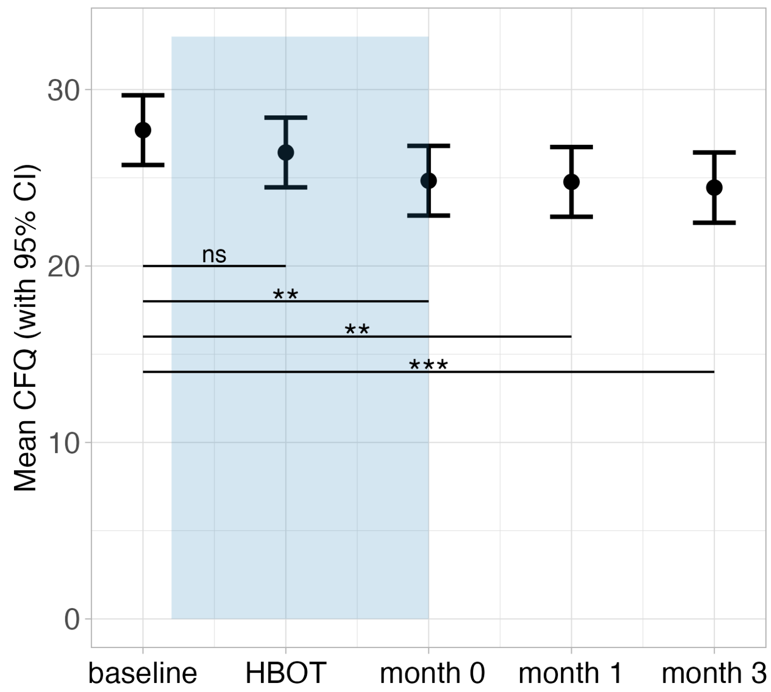


Excerpt of Additional Symptoms

SF-36 Pain

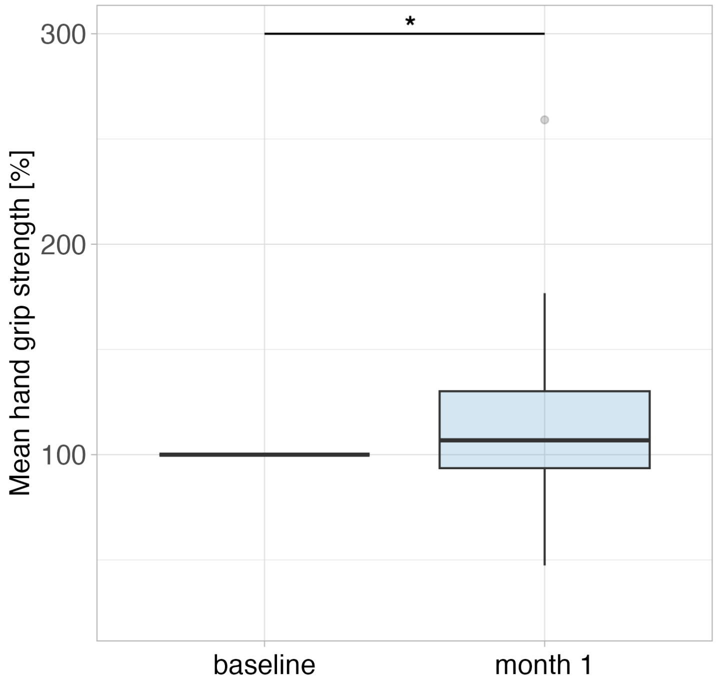


Chalder Fatigue Scale

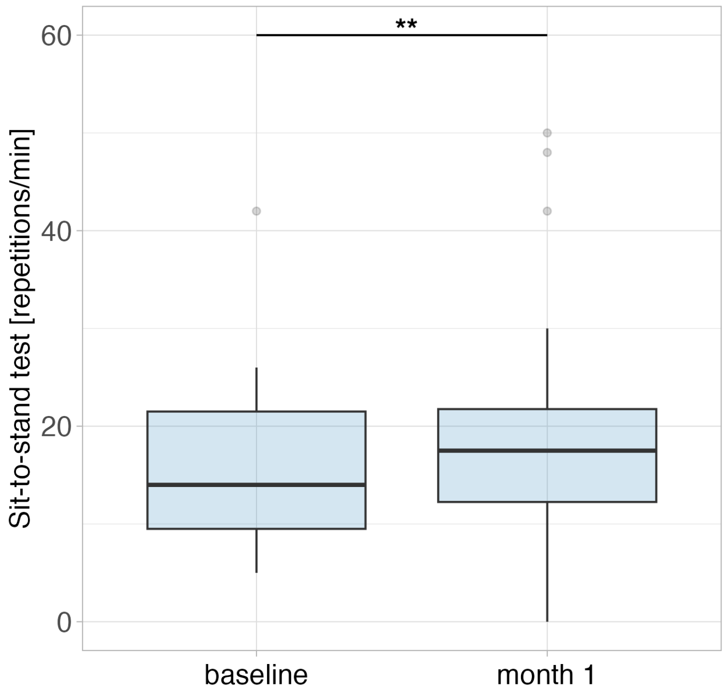


Excerpt of Additional Symptoms

Mean Handgrip Strength Before vs. After HBOT

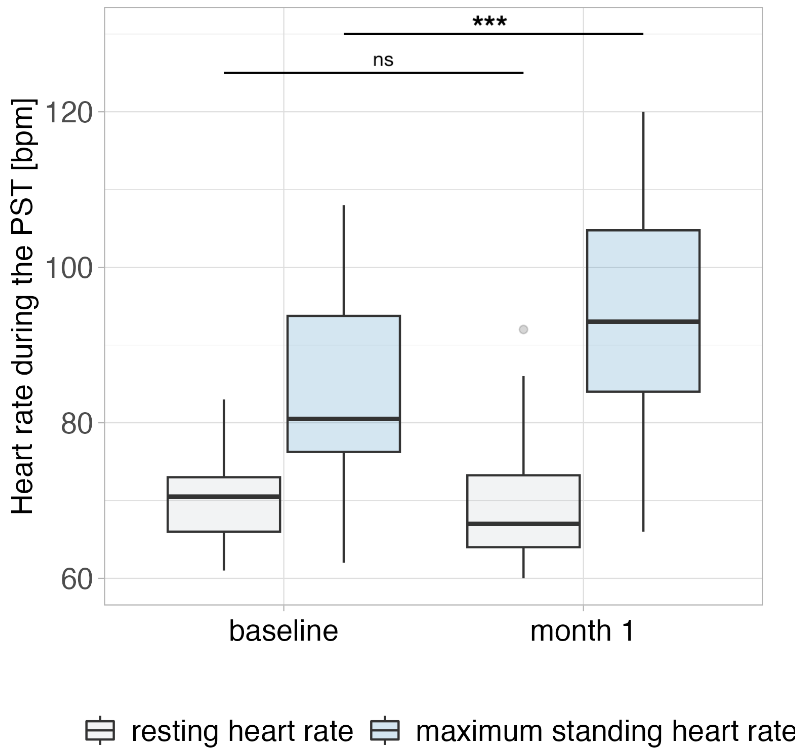


1-Minute Sit-to-Stand Test Before vs. After HBOT

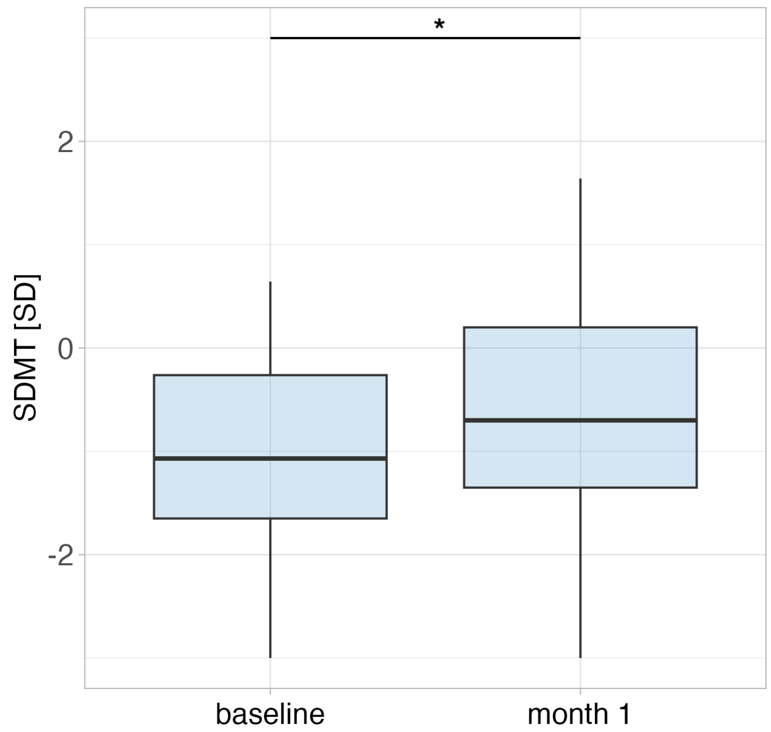


Excerpt of Additional Symptoms

Passive Standing Test



SDMT



Conclusions

40 sessions of HBOT led to...

... improvements in **physical function**

... improvements in **pain**

... improvements in **fatigue** – subjektive and objektive.

... improvements in **neurocognitive function**.

HBOT has a **favorable safety profile** in ME/CFS.

Open Questions and Areas for Further Investigation

- Are the effects sustained over several months?
- Why do some patients not respond?
- Comparison: 20 vs. 40 sessions of HBOT

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Lukas Reeß
Moritz Krill
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DFG Deutsche Forschungsgemeinschaft

ME/CFS DEUTSCHE GESELLSCHAFT FÜR ME/CFS E.V.

Bundesministerium für Bildung und Forschung

Bundesministerium für Gesundheit

WEIDENHAMMER ZÖBELE STIFTUNG

LONG COVID DEUTSCHLAND

Lost Voices Stiftung

Fatigatio e.V. Bundesverband Chronisches Erschöpfungssyndrom (CFS / CFIDS / ME)

Further information on https://cfc.charite.de/klinische_studien/nksg/

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