

Clinical Outcomes Report:

Hyperbaric Oxygen Therapy for Veterans with Chronic TBI

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Hyperbaric Oxygen Therapy (HBOT) has emerged as a potential treatment option for veterans experiencing chronic traumatic brain injury (TBI) and associated neuropsychiatric conditions.

This report presents clinical outcome data from:

- A multi-year cohort (2022–2025, n=146)
- A recent treatment cohort (2024–2025, n=80)

Across both datasets, participants demonstrated consistent improvements in:

- Cognitive performance
- Mood and emotional regulation
- PTSD, depression, and anxiety symptoms
- Suicidal ideation indicators

These findings reflect measurable, multi-domain improvements following a standardized 40-session HBOT protocol.

STUDY OVERVIEW

Study Population

- 146 veterans (2022–2025 cohort)
- 80 veterans (2024–2025 cohort; subset of the broader dataset)

Assessment Timing

- Baseline
- Midpoint (20 sessions)
- Post-treatment (40 sessions)

Assessment Tools

- ANAM (cognitive + mood)
- PCSS
- PHQ-9
- GAD-7
- PCL-M

Intervention

40-session HBOT protocol

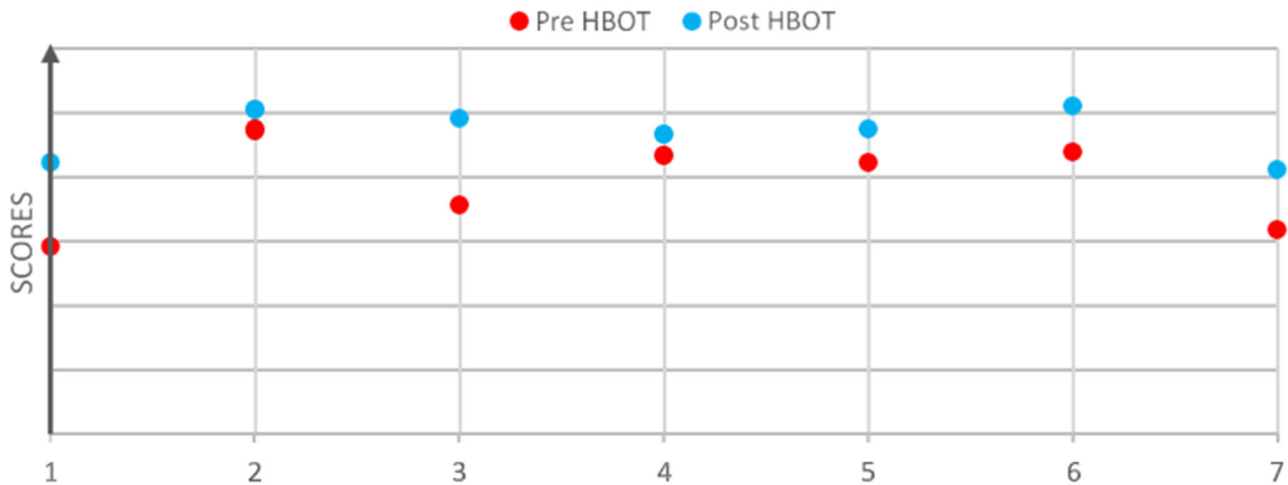
Data Validation

An Analysis of Variance (ANOVA) was conducted to compare results across the 2022 - 2025 datasets. The analysis found no statistically significant differences between the groups ($p > .05$), indicating that the datasets are comparable and can be evaluated together as a single cohort.

ANAM ANALYSIS (146 PATIENTS)

The data provided in Charts 1–3 represents 146 HBOT participants across combined datasets. Participants were assessed using the Automated Neuropsychological Assessment Metrics (ANAM) prior to and following treatment.

CHART #1: North Carolina 2022 - 2025 HBOT Programs ANAM Scores for 146 Patients



1 = Simple Reaction Time; 2 = Code Substitution Learning; 3 = Procedural Reaction Time; 4 = Mathematical Processing; 5 = Matching to Sample; 6 = Code Substitution Delayed; 7 = Simple Reaction Time Repeated

CHART #2: North Carolina 2022 - 2025 HBOT Programs
 ANAM Negative Mood Scores for 146 Patients

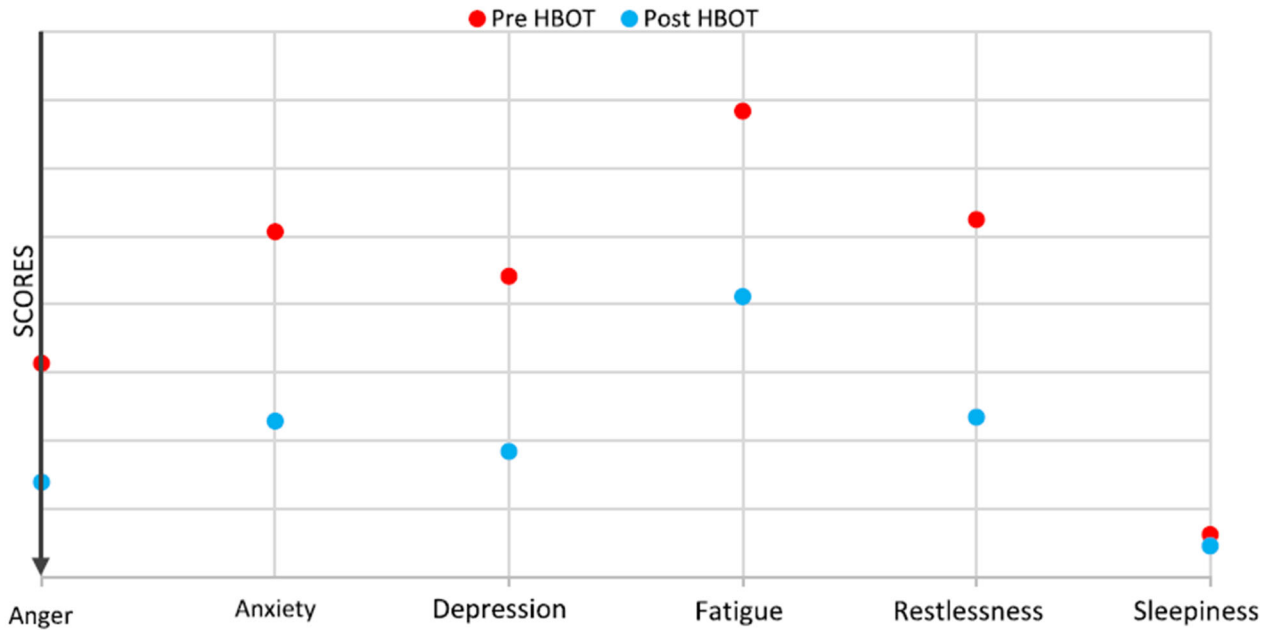
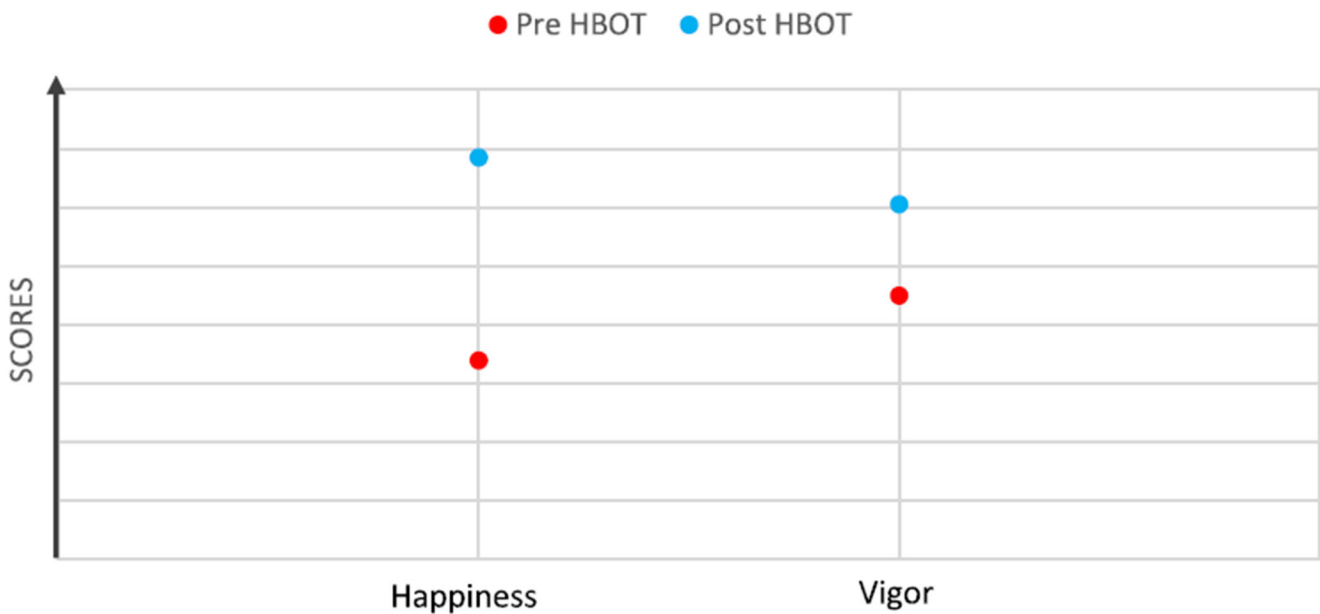


CHART #3: North Carolina 2022 - 2025 HBOT Programs
 ANAM Positive Mood Scores for 146 Patients



All 146 Veterans experienced an increase in positive mood as shown in Chart #3 above. This outcome taken together with a decrease in negative mood indicators as shown in Chart #2, is correlated with reduced suicidality.

COMBINED ANAM ANALYSIS RESULTS FOR 146 PATIENTS

All fifteen ANAM test scores (100%) showed statistically significant improvement between pre- and post-treatment assessments.

Key findings:

- Reduction in anxiety, depression, and anger
- Improved sleep and reduced restlessness
- Increased happiness and vigor
- Improved attention, concentration, and reasoning

These changes align with prior research linking reductions in negative mood states to reduced suicidal ideation.

Table 1: Paired Samples of the ANAM Throughput and Mood Scores

Degrees of Freedom=145	Paired Differences*					Analysis Results t	Test Significance**
	Mean	Std. Deviation	Std. Error Mean	95% Confidence Interval of the Difference			
				Lower	Upper		
<u>ANAM Test</u>							
Simple Reaction Time	-13.123	27.066	2.240	-17.551	-8.696	-5.859	<.001
Code Substitution Learning	-3.089	14.566	1.205	-5.472	-.706	-2.562	.011
Procedural Reaction Time	-13.469	18.823	1.563	-16.559	-10.379	-8.616	<.001
Mathematical Processing	-3.308	14.293	1.183	-5.646	-.970	-2.797	.006
Matching to Sample	-5.322	13.731	1.136	-7.568	-3.076	-4.683	<.001
Code Substitution-Delayed	-7.329	17.141	1.419	-10.133	-4.525	-5.166	<.001
Simple Reaction Time-Repeated	-9.548	26.210	2.169	-13.835	-5.261	-4.402	<.001
<u>ANAM Mood Scales</u>							
Anger	8.71425	18.28467	1.51325	5.72337	11.70512	5.759	<.001
Anxiety	13.91151	19.25178	1.59329	10.76244	17.06058	8.731	<.001
Depression	12.86137	19.76032	1.63538	9.62912	16.09362	7.864	<.001
Fatigue	13.61466	20.52888	1.69898	10.25669	16.97263	8.013	<.001
Happiness	-34.62504	20.55324	1.93349	-38.45600	-30.79409	-17.908	<.001
Restlessness	14.50842	18.68506	1.54639	11.45205	17.56480	9.382	<.001
Vigor	-15.56267	22.67803	1.87685	-19.27218	-11.85316	-8.292	<.001
Sleepiness	.829	1.450	.120	.592	1.066	6.908	<.001

* Paired Difference test provides a comparison of the Pre and Post testing to determine whether significant change has occurred.

** Test significance is statistically defined as less than .05

Clinical Outcomes (2022–2025 Cohort, n=146)

The following results are based on standardized pre- and post-treatment assessments across validated clinical instruments. While ANAM data reflects improvements in cognitive performance and mood, these measures evaluate symptom-specific clinical outcomes.

Post-Concussion Symptoms (PCSS)

- Baseline: 36.9
- Post-40: 17.5
- Mean reduction: 19.4 points
(53% improvement)

Depression (PHQ-9)

- Baseline: 10.9
- Post-40: 4.8
- Mean reduction: 6.1 points
(56% improvement)

A reduction ≥ 5 points is clinically meaningful.

Anxiety (GAD-7)

- Baseline: 9.6
- Post-40: 4.4
- Mean reduction: 5.2 points
(54% improvement)

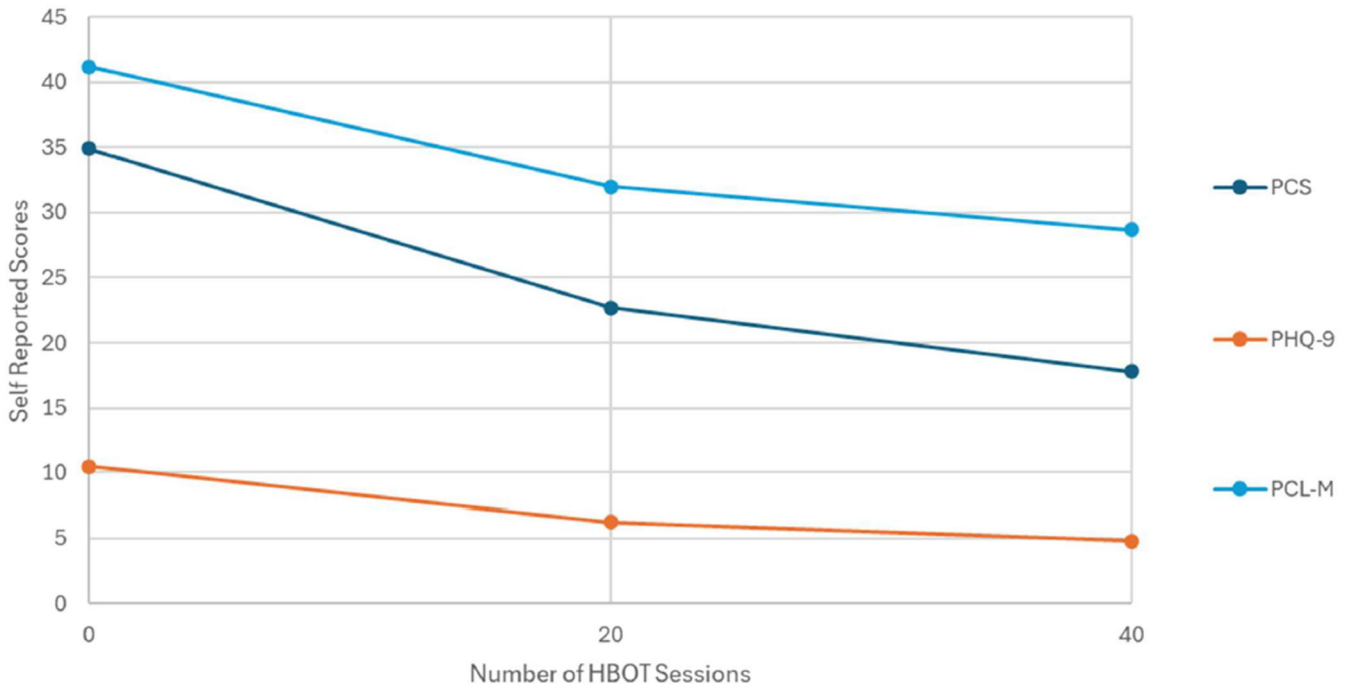
A reduction ≥ 4 points is clinically meaningful.

PTSD (PCL-M)

- Baseline: 42.4
- Post-40: 28.9
- Mean reduction: 13.5 points
(32% improvement)

A reduction ≥ 10 points is clinically meaningful.

2025 Mean self reported scores for PCS, PHQ, PCL-M



Median outcomes demonstrated similar patterns of improvement and are included in the appendix for reference.

SUMMARY OF IMPACT

Across the 2022–2025 cohort:

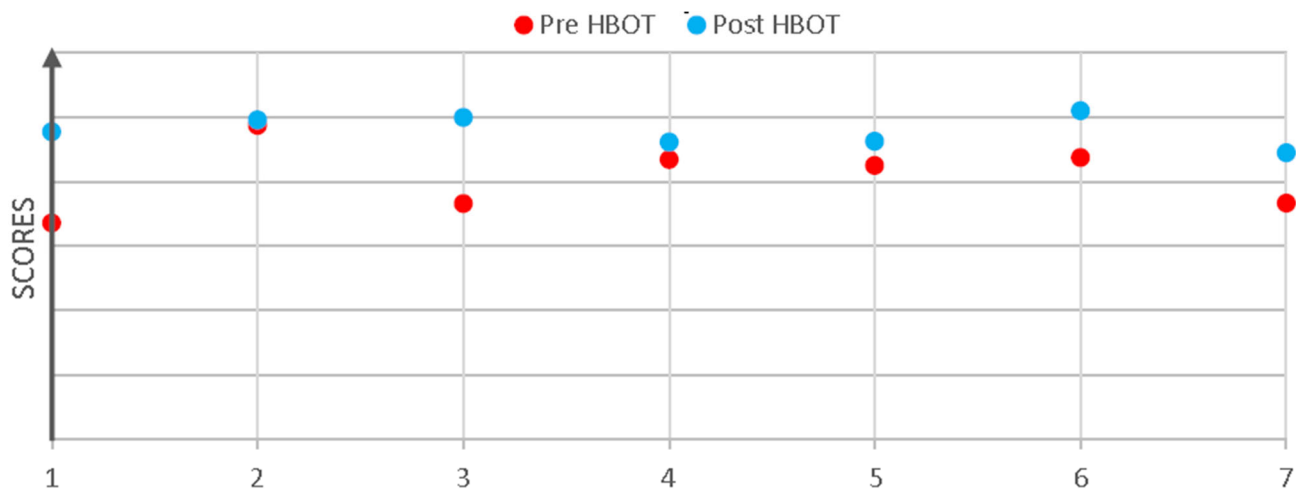
- Post-concussion symptoms decreased by ~50%
- Depression and anxiety decreased by 45–56%
- PTSD symptoms decreased by ~31–32%
- Improvements exceeded established clinical significance thresholds
- Suicidal ideation remained low, with resolution rates exceeding emergence across both cohorts.

These findings demonstrate consistent, multi-domain symptom improvement in veterans with chronic TBI.

2024–2025 COHORT (n=80)

This section presents outcomes from a focused cohort treated between 2024 and 2025 using the same 40-session protocol. Findings were consistent with the broader multi-year dataset, demonstrating similar improvements in cognitive performance, mood, and symptom reduction.

CHART #4: North Carolina October 2024 – December 2025 HBOT Programs ANAM Scores for 80 Patients



1 = Simple Reaction Time; 2 = Code Substitution Learning; 3 = Procedural Reaction Time; 4 = Mathematical Processing; 5 = Matching to Sample; 6 = Code Substitution Delayed; 7 = Simple Reaction Time Repeated

CHART #5: North Carolina October 2024 – December 2025 HBOT Programs
ANAM Negative Mood Scores for 80 Patients

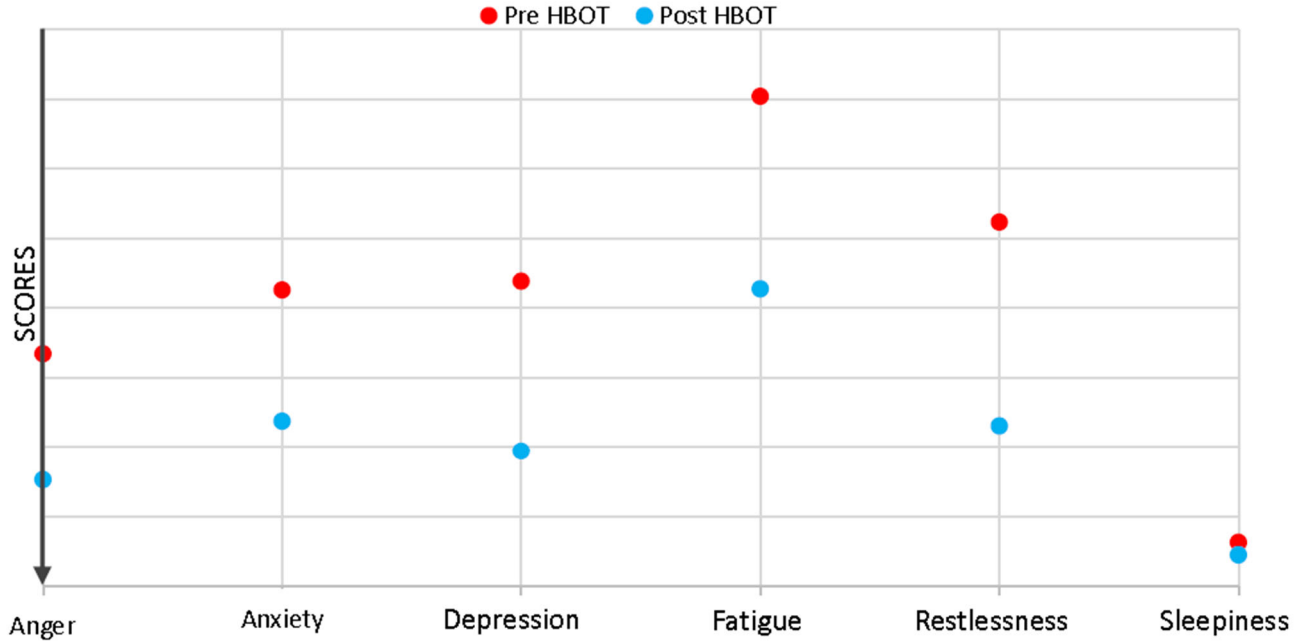
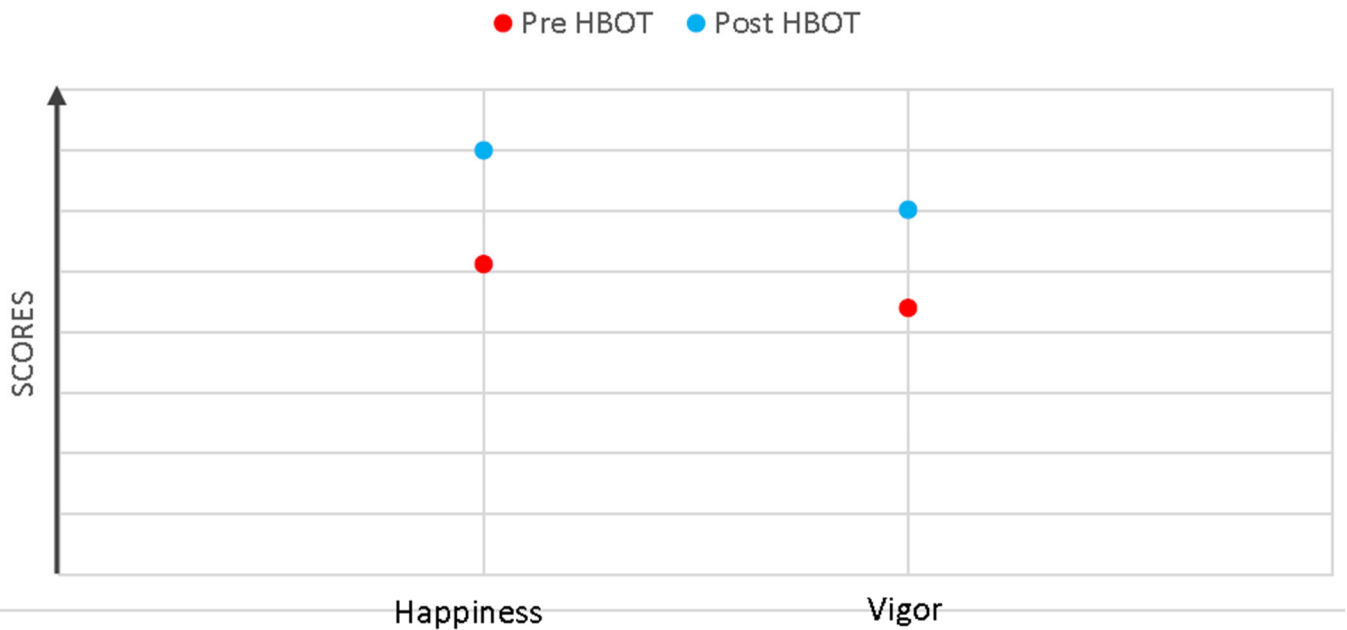


CHART #6: North Carolina October 2024 – December 2025 HBOT Programs
ANAM Positive Mood Scores for 80 Patients



All 80 veterans experienced:

- decreased negative mood
- increased positive mood
- improvements correlated with reduced suicidality

Key Outcomes

- Post-concussion symptoms ↓ ~47–49%
- Depression ↓ ~45–54%
- Anxiety ↓ ~50–53%
- PTSD ↓ ~26–30

SUICIDAL IDEATION & SAFETY

2022–2025 Cohort (n=146)

- 78.1% no ideation
- 12.3% resolution
- 8.9% persistent
- 0.7% emergent

2024–2025 Cohort (n=80)

- 83.8% no ideation
- 8.8% resolution
- 6.3% persistent
- 1.3% emergent

Among participants who reported suicidal ideation at intake, approximately **58% experienced resolution** by the end of treatment, indicating meaningful improvement within this higher-risk subgroup. No safety signal suggesting treatment-associated worsening was observed.

CONTEXT: VETERAN SUICIDE

Suicide remains a significant public health concern within the veteran population. These figures underscore the ongoing urgency of identifying effective interventions for veterans at elevated risk.

- 6,407 veteran deaths by suicide (2022)
- ~17.6 per day
- Rate: 34.7 per 100,000

Veterans with TBI have approximately **95% higher suicide risk** than those without TBI.

Monitoring suicidal ideation is a critical safety component when evaluating treatment interventions.

IMPLICATIONS FOR FUNDING & POLICY

Chronic TBI in veterans is associated with:

- long-term disability
- increased healthcare utilization
- reduced workforce participation
- elevated risk of depression, PTSD, and suicide

The magnitude and consistency of improvements observed suggest that HBOT may represent a meaningful therapeutic option for veterans with chronic TBI. While observational, these findings support continued evaluation and consideration for expanded access and funding pathways.

APPENDIX A: ANAM Data Table (Pre- and Post-Treatment Scores)

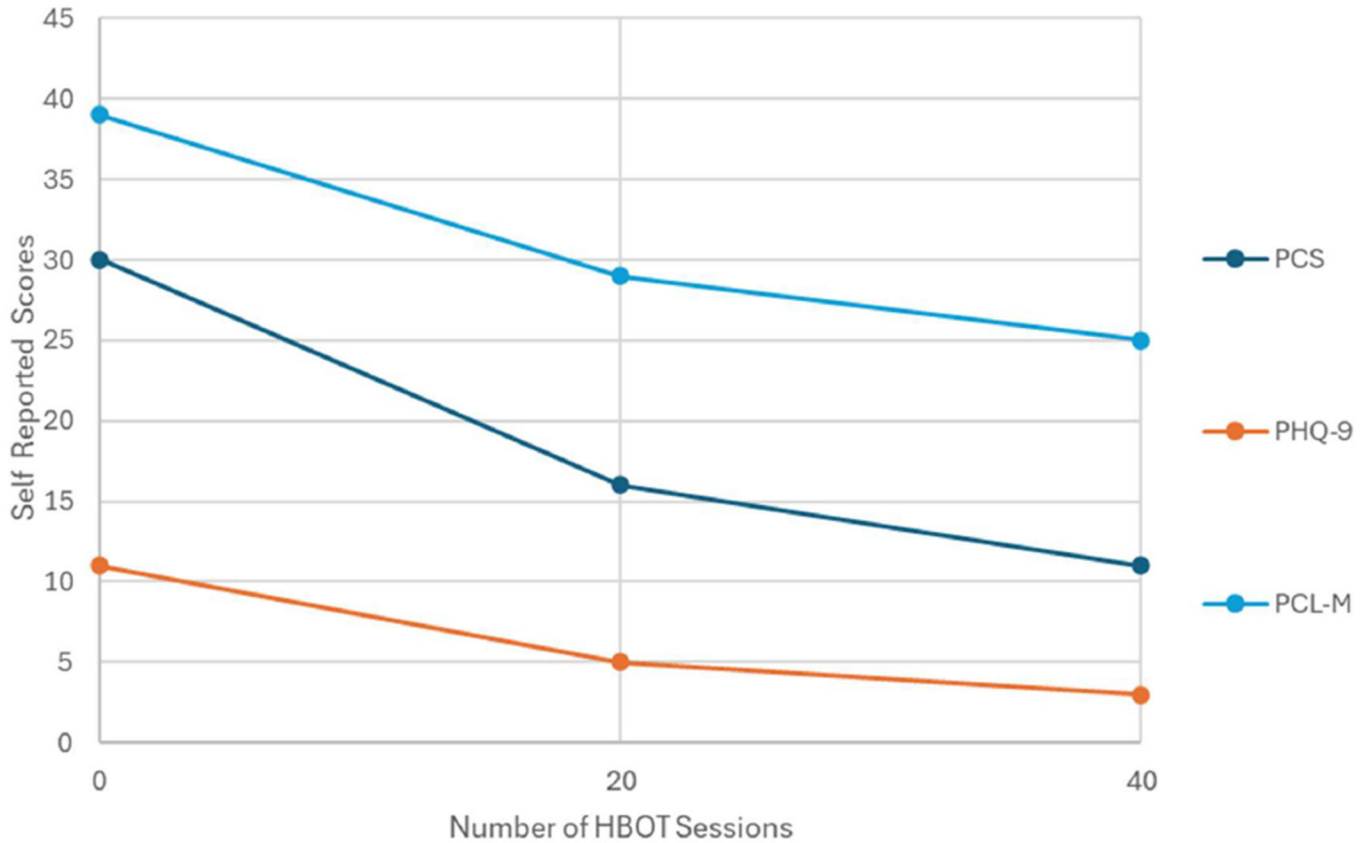
The following table presents the mean, standard deviation, and standard error values used to construct the ANAM cognitive and mood outcome charts for the 2022–2025 cohort (n=146). [Charts 1-3]

N=146	Mean	Std. Deviation	Std. Error Mean
Pre Simple Reaction Time	79.10	30.448	2.520
Post Simple Reaction Time	92.23	26.435	2.188
Pre Code Substitution-Learning	97.36	18.788	1.555
Post Code Substitution-Learning	100.45	15.891	1.315
Pre Procedural Reaction Time	85.70	25.030	2.079
Post Procedural Reaction Time	99.17	19.795	1.644
Pre Mathematical Processing	93.27	19.061	1.577
Post Mathematical Processing	96.58	20.766	1.719
Pre Matching to Sample	92.13	16.294	1.349
Post Matching to Sample	97.45	16.085	1.331
Pre Code Substitution Delayed	93.83	17.873	1.479
Post Code Substitution Delayed	101.16	21.026	1.740
Pre Simple Reaction Time-Repeated	81.70	28.267	2.339
Post Simple Reaction Time-Repeated	91.25	24.647	2.040
Pre Anger	15.6779	21.72958	1.79835
Post Anger	6.9636	12.73617	1.05405
Pre Anxiety	25.3423	23.62566	1.95527
Post Anxiety	11.4308	14.92590	1.23528
Pre Depression	22.0702	25.24808	2.08955
Post Depression	9.2088	15.77997	1.30596
Pre Fatigue	34.2008	20.40141	1.68843
Post Fatigue	20.5862	19.95813	1.65175
Pre Happiness	33.88	13.608	1.280
Post Happiness	68.5100	23.61002	2.22104
Pre Restlessness	26.2480	22.98062	1.90189
Post Restlessness	11.7396	15.29047	1.26545
Pre Vigor	44.9584	22.03208	1.82339
Post Vigor	60.5210	26.01297	2.15285
Pre Sleepiness	3.10	1.312	.109
Post Sleepiness	2.27	1.289	.107

Appendix B: Median Outcomes

The following chart presents median outcome values for the same cohort. Median values provide an additional measure of central tendency and help account for variability within the dataset.

2025 Median self reported scores for PCS, PHQ, PCL-M



Works Cited (MLA Format)

PCSS info :

1) Langevin P, Frémont P, Fait P, Roy JS. Responsiveness of the Post-Concussion Symptom Scale to Monitor Clinical Recovery After Concussion or Mild Traumatic Brain Injury. *Orthop J Sports Med.* 2022 Oct 12;10(10):23259671221127049. doi: 10.1177/23259671221127049. PMID: 36250029; PMCID: PMC9561659.

2) <https://www.theraplatform.com/blog/1666/mcid-minimal-clinically-important-difference#:~:text=What%20is%20the%20minimal%20clinically,both%20measurable%20and%20clinically%20meaningful.>

PHQ-9 Info:

3) Carlo, Andrew D et al. "Associations of Common Depression Treatment Metrics With Patient-centered Outcomes." *Medical care* vol. 59,7 (2021): 579-587. doi:10.1097/MLR.0000000000001540

GAD-7

4) Toussaint, Anne et al. "Sensitivity to change and minimal clinically important difference of the 7-item Generalized Anxiety Disorder Questionnaire (GAD-7)." *Journal of affective disorders* vol. 265 (2020): 395-401. doi:10.1016/j.jad.2020.01.032

Suicidal Ideation resources

5) U.S. Department of Veterans Affairs. 2024 National Veteran Suicide Prevention Annual Report: 2022 Data. U.S. Department of Veterans Affairs, 2024, www.mentalhealth.va.gov/docs/data-sheets/2024/2024-Annual-Report-Part-2-of-2_508.pdf.

6) U.S. Department of Veterans Affairs, Office of Mental Health and Suicide Prevention. National Veteran Suicide Prevention Annual Report: Executive Summary. U.S. Department of Veterans Affairs, 2024, www.mentalhealth.va.gov/suicide_prevention/data.asp.

7) MDC is used to determine if a patient has truly changed beyond measurement error, while MCID is used to determine if that change resulted in a functional, subjective improvement in symptoms.