



## Effects of Daily NanoVi Exo<sup>®</sup> Sessions on Sleep Quality, Emotional Well-Being, Fatigue, and Physiological Resilience in Older Adults: A 30-Day Exploratory Study

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## Effects of Daily NanoVi Exo® Sessions on Sleep Quality, Emotional Well-Being, Fatigue, and Physiological Resilience in Older Adults: A 30-Day Exploratory Study

### ABSTRACT

**Background:** Aging is associated with physiological decline and increased vulnerability to stress, fatigue, and poor sleep quality. Interventions that support cellular and systemic resilience may offer meaningful benefits for older adults. This exploratory report integrates data from two small pilot studies conducted independently but following similar 30-day NanoVi Exo® intervention protocols in older adults.

**Methods:** Fifteen adults (mean age: 69.67 years) participated in a 30-day intervention involving daily 20-minute NanoVi Exo® sessions. Participants completed assessments at baseline, day 15, and day 30, including self-reported sleep and fatigue questionnaires, as well as the DASS-21 and PROMIS-29 instruments. Physiological assessments—including PPG Stress Flow and HEG (Biotekna, Italy)—were conducted at baseline and post-intervention. Changes over time were analyzed using appropriate parametric and non-parametric tests. Effect sizes (Cohen's *d*) were calculated to assess the magnitude of change.

**Results:** Following the intervention, participants demonstrated multidimensional improvements across both physiological and self-reported wellness indicators. While physiological parameters did not reach statistical significance, favorable trends were observed in measures of autonomic nervous system function and cerebral oxygenation, including increases in HRV indices and cerebral blood flow metrics.

More pronounced effects were seen in self-reported outcomes. Participants reported improvements in sleep quality, including reductions in sleep latency, nighttime awakenings, and daytime sleepiness. Emotional well-being also improved, with reductions in self-reported stress ( $p = 0.0316$  DASS-21), anxiety ( $p = 0.0167$ ,  $p = 0.0495$  PROMIS-29), and depressive symptoms. Fatigue levels decreased over time, and participants reported gains in physical function and social role participation, along with reductions in pain interference and intensity.

**Conclusion:** Thirty days of daily NanoVi Exo® sessions were associated with meaningful improvements in perceived sleep quality, emotional well-being, pain and fatigue in older adults, with supportive trends in physiological resilience. These findings suggest the potential of the intervention to enhance multiple dimensions of wellness in aging populations and support further investigation in larger, controlled trials.

**Keywords:** Heart Rate Variability; Sleep Quality; Fatigue; Well-being; Physiological Resilience.

## NanoVi Exo® Wellness Study –Report

### Methods

This study aimed to evaluate the wellness benefits of the NanoVi Exo® device in adults aged 60 and over, specifically examining its effects on cellular health, physiological resilience, and overall well-being. A total of fifteen adults (8 males, 7 females, mean age of 69.67 years old) participated in the study. The analysis combines data from two pilot cohorts that shared identical study design, assessment tools, and duration, allowing for an integrated evaluation of outcomes across both groups.

After signing an informed consent form, participants completed baseline assessments, which included self-reported sleep and fatigue questionnaires, as well as the DASS-21 and PROMIS-29 instruments. Additionally, they underwent physiological evaluations using the HEG and PPG Stress Flow devices (Biotekna, Italy). A mescreen™ test was also performed to assess mitochondrial efficiency and function. Fifteen days later, participants repeated all the initial questionnaires as a midpoint evaluation. Thirty days later, participants completed all the questionnaires and underwent another round of HEG and PPG Stress Flow analyses. The intervention consisted of daily 20 min-NanoVi Exo® Sessions for 30 days.

Statistical analyses were performed using GraphPad Prism® (v. 8.0). Outliers were identified and excluded when appropriate. Data normality was assessed with the Shapiro-Wilk test. For questionnaire data, a Kruskal-Wallis' or one-way ANOVA test were used to evaluate changes across pre-, midpoint, and post-evaluations, followed by Dunn's or Tukey's multiple comparisons test for pairwise comparisons. For physiological parameters, paired and unpaired t-tests were applied to compare pre- and post-session data. Non-parametric data were analyzed using Wilcoxon or Mann-Whitney tests, as appropriate. Results were presented as mean  $\pm$  standard deviation (SD) for each group and considered statistically significant at  $p < 0.05$ . Percentage differences were calculated using Microsoft Excel® and expressed in relation to baseline values. Effect sizes (Cohen's  $d$ ) were also calculated to assess the magnitude of changes from baseline to post-intervention, providing a measure of practical significance in addition to statistical significance.

## Results

### 1. 30-Day Effects on Physiological Parameters

#### 1.1 PPG Stress Flow – Mean Heart Rate

Mean heart rate (HR) represents the average number of heart beats per minute, serving as a baseline measure of cardiovascular function. It provides insights into the activity of the autonomic nervous system (ANS) and overall cardiovascular health. An optimal heart rate reflects a balanced autonomic response, with normative values ranging between 46.9 and 84.8 beats per minute. No differences were observed in mean HR after the intervention period (Figure 1A).

#### 1.2 PPG Stress Flow – Standard Deviation of NN intervals (SDNN)

SDNN is a key clinical index of heart rate variability (HRV), reflecting the overall health and adaptability of the autonomic nervous system. It represents the standard deviation of beat-to-beat intervals (NN intervals) over a 5-minute period, with a minimum normal value of 50 ms.

Although no statistically significant differences were observed, SDNN values increased by 6% after the intervention period, moving closer to normal values (Figure 1B).

#### 1.3 PPG Stress Flow - Root Mean Square of Successive Differences (RMSSD)

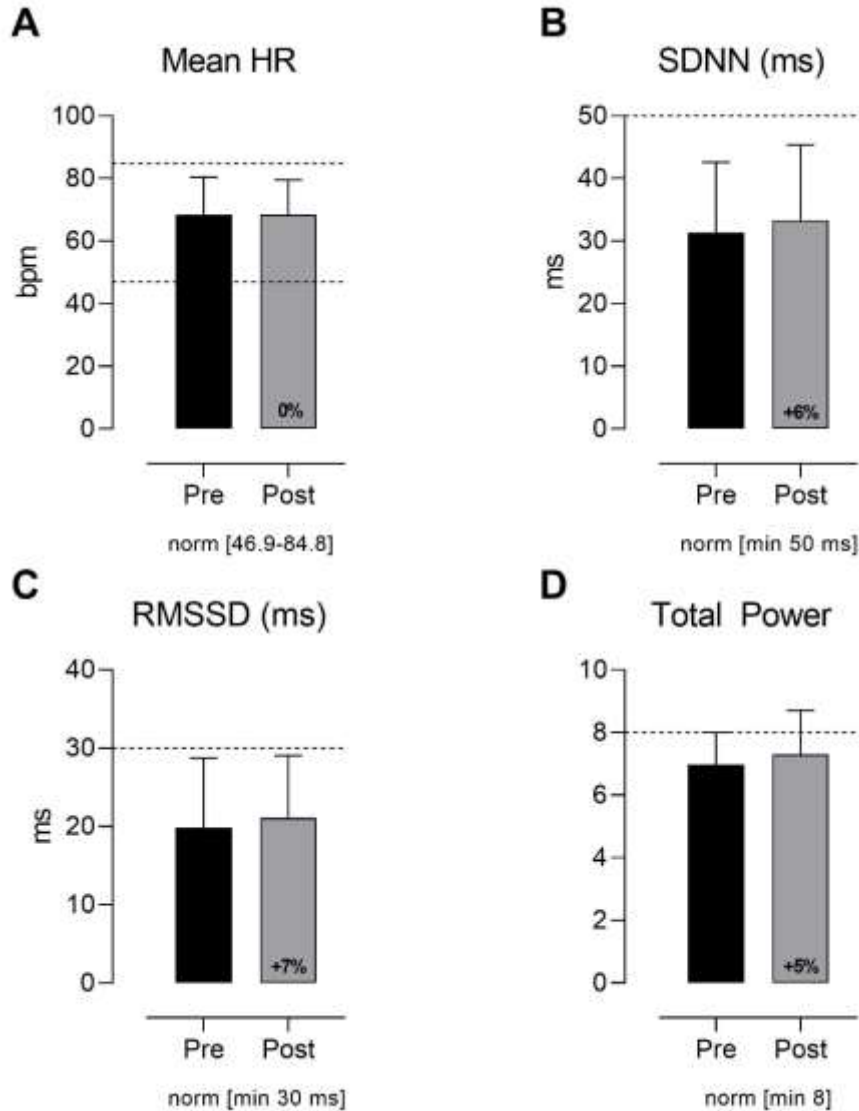
RMSSD is a measure of the vagal (parasympathetic) component of heart rate variability, reflecting the heart's capacity to respond to vagal modulation. It serves as an indicator of parasympathetic nervous system function and emotional resilience. The minimum normal value is 30 ms.

Although no statistically significant differences were observed, RMSSD values increased by 7% after the intervention period, moving closer to normal values (Figure 1C).

#### 1.4 PPG Stress Flow – Total Power

Total power represents the overall activity of the autonomic nervous system, encompassing both sympathetic and parasympathetic components. It provides a comprehensive measure of autonomic balance, with a minimum normal value of 8.

Although no statistically significant differences were observed, Total Power values increased by 5% after the intervention period, moving closer to normal values (Figure 1D).

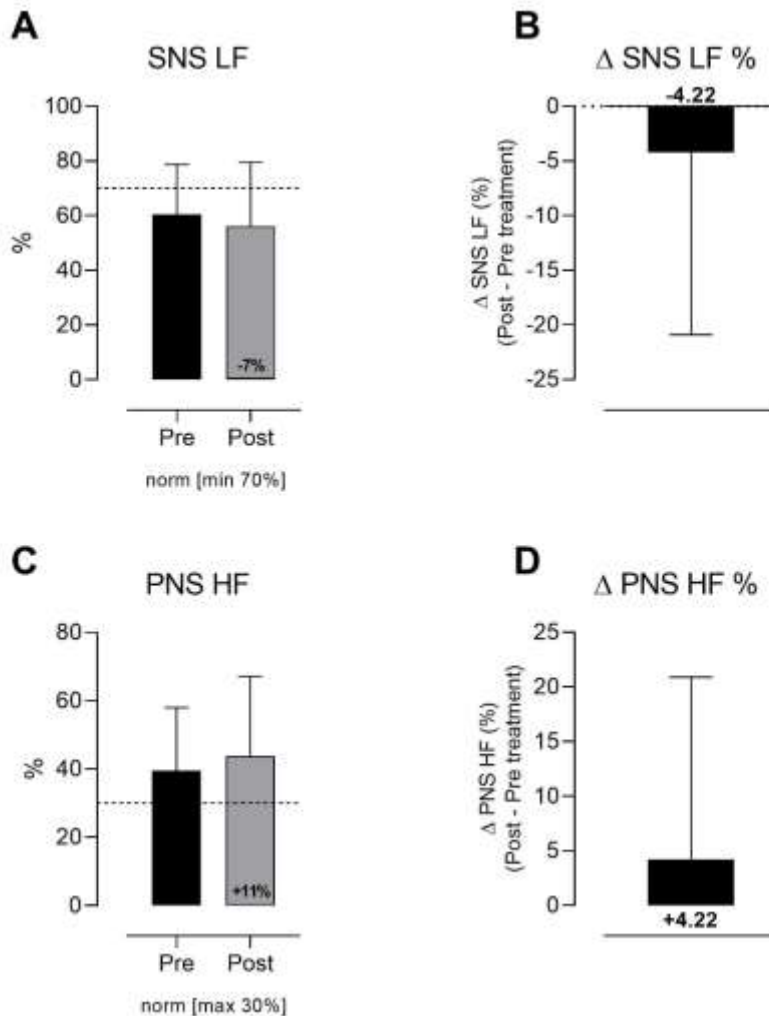


**Figure 1.** Mean Heart rate, SDNN, RMSSD and Total Power parameters before and after 30 days of daily NanoVi Exo® sessions.

### 1.5 PPG Stress Flow - SNS LF% and PNS HF%

These percentages represent the relative dominance of the sympathetic (SNS LF%) and parasympathetic (PNS HF%) nervous systems, with their sum equaling 100%. The minimum normal value for SNS LF% is 70%, and the maximum normal value for PNS HF% is 30%.

No statistically significant difference was observed. However, there was a 7% reduction in SNS LF% values (mean: 56.15) and a 11% increase in PNS HF% values (mean: 43.85) after the intervention period, resulting in a corresponding delta change of 4.22 (Figure 2).



**Figure 2.** SNS LF (%) and PNS HF (%) before and after 30 days of daily NanoVi Exo® sessions.

### 1.6 HEG – Cerebral Blood Oxygenation (rCBO<sub>2</sub>)

Cerebral Blood Oxygenation (rCBO<sub>2</sub>) measures the concentration of oxygenated blood in the prefrontal cortex (PFC). Adequate rCBO<sub>2</sub> is essential for cognitive function, emotional regulation, and overall mental well-being, as it indicates sufficient oxygen delivery to meet the brain's metabolic needs. Balanced rCBO<sub>2</sub> is associated with optimal neural activity, effective attention, decision-making, and stress resilience. The normal range is 50–150 units.

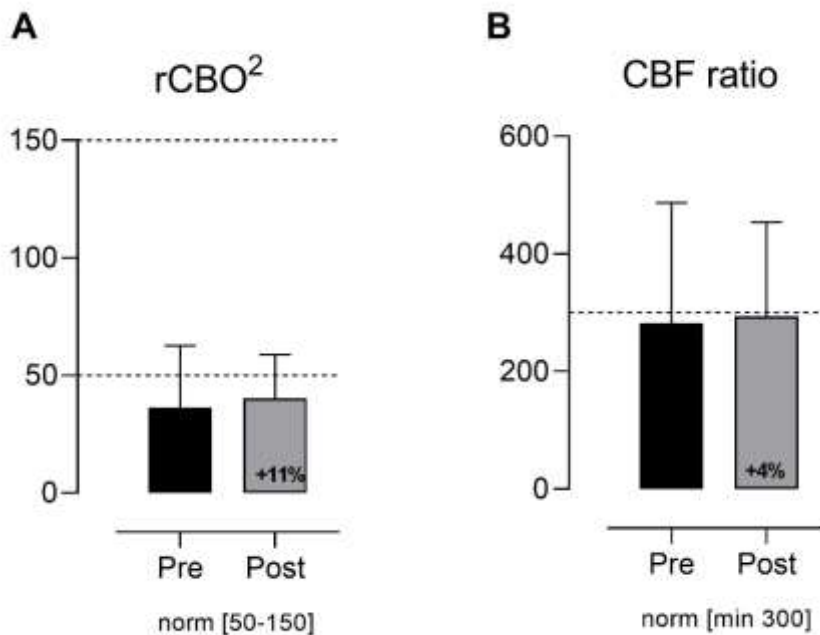
No statistically significant differences were observed; however, an 11% increase in rCBO<sub>2</sub> values was noted after the intervention period (Figure 3A).

### 1.7 HEG - Cerebral Blood Flow (CBF) Status

Cerebral Blood Flow (CBF) reflects the amount of blood circulating through the prefrontal cortex (PFC). Adequate CBF is essential for delivering oxygen and

nutrients required for cognitive functions, emotional regulation, and stress management. It ensures the PFC can effectively support decision-making, attention, and executive functions. The minimum normal value is 300.

No statistically significant differences were observed, but CBF values increased by 4% after the intervention period (Figure 3B), moving closer to normal values.



**Figure 3.** Cerebral Blood Oxygenation, slope and standard deviation, and cerebral blood flow parameters before and after 30 days of daily NanoVi Exo® sessions.

**Table 1.** Descriptive Statistics of Physiological data.

| Mean Heart Rate |               |                       |               |           |             |
|-----------------|---------------|-----------------------|---------------|-----------|-------------|
| Group           | Mean ± SD     | Median (IQR)          | 95% CI (mean) | Cohen's d | Effect size |
| Pre (n=15)      | 68.47 ± 11.96 | 64.50(59.60 – 78.00)  | 61.84 – 75.09 | -         | -           |
| Post (n=15)     | 68.42 ± 11.05 | 68.20 (60.70 – 76.20) | 62.30 – 74.54 | 0.00      | -           |
| SDNN            |               |                       |               |           |             |
| Group           | Mean ± SD     | Median (IQR)          | 95% CI (mean) | Cohen's d | Effect size |
| Pre (n=14)      | 31.36 ± 11.20 | 28.00 (21.50 – 40.75) | 24.89 – 37.82 | -         |             |
| Post (n=13)     | 33.31 ± 12.06 | 39.00 (20.50 – 43.50) | 26.02 – 40.59 | 0.17      | Very small  |
| RMSSD (ms)      |               |                       |               |           |             |
| Group           | Mean ± SD     | Median (IQR)          | 95% CI (mean) | Cohen's d | Effect size |

|                         |                  |                       |                        |                  |                    |
|-------------------------|------------------|-----------------------|------------------------|------------------|--------------------|
| Pre (n=14)              | 19.79 ± 8.95     | 15.50 (14.75 – 27.00) | 14.62 – 24.95          | -                |                    |
| Post (n=13)             | 21.08 ± 7.98     | 18.00 (15.00 – 27.00) | 16.25 – 25.90          | 0.15             | Very small         |
| <b>Total Power</b>      |                  |                       |                        |                  |                    |
| <b>Group</b>            | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (mean)</b>   | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)              | 6.97 ± 1.03      | 6.94 (6.19 – 7.49)    | 6.40 – 7.54            | -                |                    |
| Post (n=15)             | 7.30 ± 1.40      | 7.35 (6.34 – 7.82)    | 6.53 – 8.08            | 0.27             | Small              |
| <b>SNS LF%</b>          |                  |                       |                        |                  |                    |
| <b>Group</b>            | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (mean)</b>   | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)              | 60.37 ± 18.42    | 57.20 (48.70 – 76.40) | 50.18 – 70.57          | -                |                    |
| Post (n=15)             | 56.15 ± 23.33    | 61.70 (31.40 – 75.60) | 43.23 – 69.07          | 0.15             | Very small         |
| <b>PNS LF%</b>          |                  |                       |                        |                  |                    |
| <b>Group</b>            | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (mean)</b>   | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)              | 39.63 ± 18.42    | 42.80 (23.60 – 51.30) | 29.43 – 49.82          | -                |                    |
| Post (n=15)             | 43.85 ± 23.33    | 38.30 (24.40 – 68.60) | 30.93 – 56.77          | 0.20             | Small              |
| <b>rCBO<sup>2</sup></b> |                  |                       |                        |                  |                    |
| <b>Group</b>            | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=14)              | 36.27 ± 26.48    | 25.10 (19.13 – 52.45) | 18.00 – 55.90          | -                |                    |
| Post (n=15)             | 40.21 ± 18.55    | 35.30 (27.00 – 50.20) | 27.00 – 50.20          | 0.17             | Very small         |
| <b>CBF</b>              |                  |                       |                        |                  |                    |
| <b>Group</b>            | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)              | 281.7 ± 204.9    | 224 (102 – 364)       | 102.00 – 364.00        | -                |                    |
| Post (n=15)             | 293.6 ± 160.8    | 208 (174 – 493)       | 174.00 – 493.00        | 0.06             | Very small         |

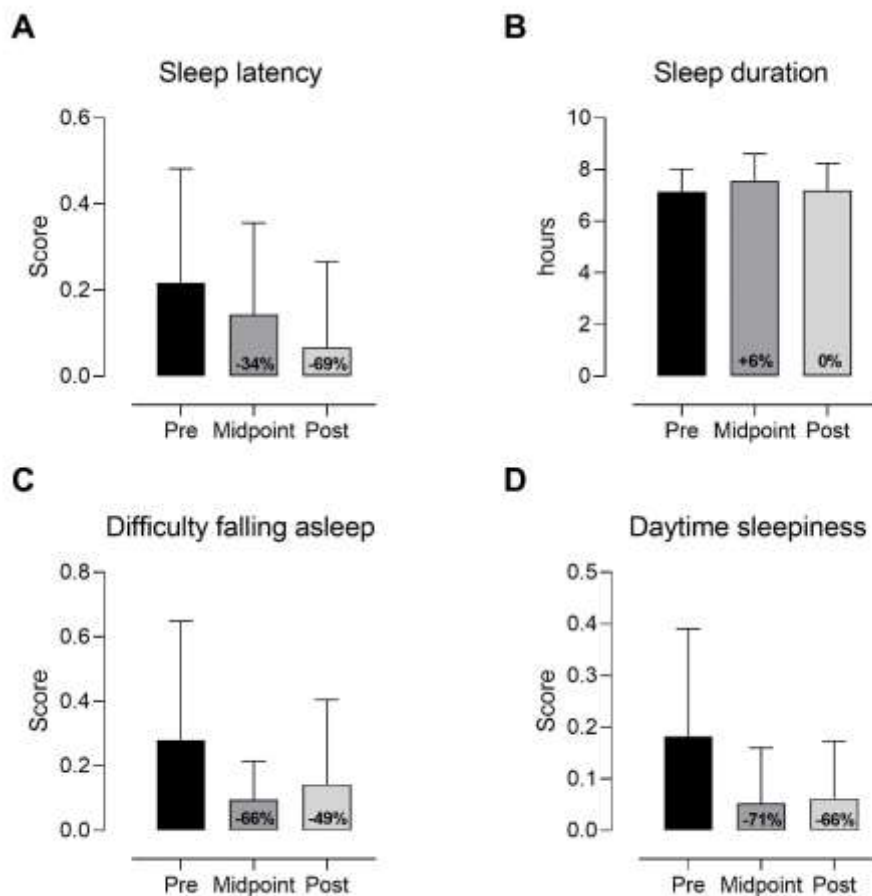
n = number of participants; CI = 95% Confidence Interval; SD = Standard Deviation; IQR = Interquartile Range. For non-parametric data, values are presented as 95% CI of the median. For parametric data, values are presented as 95% CI of the mean.

## 2. Questionnaires

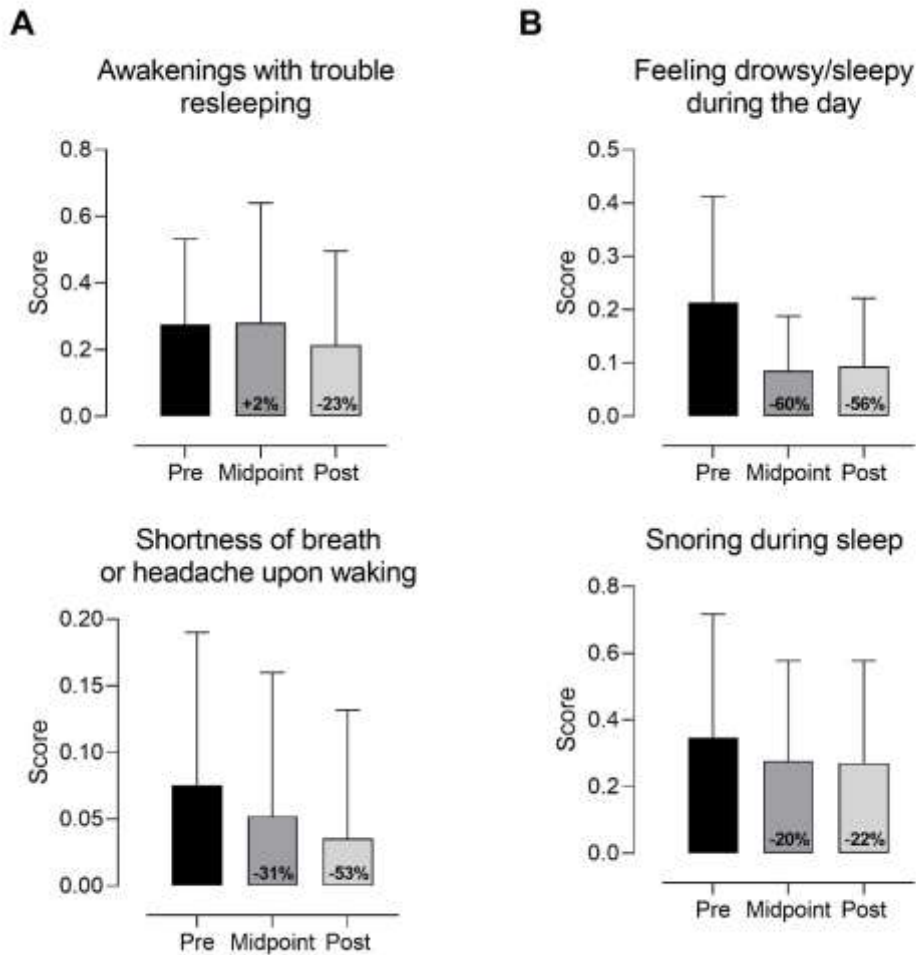
### 2.1 Sleep Questionnaire

Participants completed a self-report questionnaire developed for the study to assess changes in sleep-related outcomes. After 30 days of daily NanoVi Exo® sessions, participants demonstrated notable improvements across several sleep domains, although these changes did not reach statistical significance.

Specifically, sleep latency decreased by 69% (Figure 4A), and the Difficulty falling asleep component was reduced by 49% (Figure 4C). A 66% reduction in Daytime sleepiness was also observed (Figure 4D). Additional improvements included a 23% reduction in Awakening with trouble resleeping (Figure 5A), a 56% reduction in Feeling drowsy or sleepy during the day (Figure 5B), a 53% reduction in Shortness of breath or headache upon waking (Figure 5C), and a 22% reduction in Snoring (Figure 5D). However, no change was observed in Sleep duration (Figure 4B).



**Figure 4.** Self-reported sleep before, at midpoint, and after 30 days of daily NanoVi Exo® sessions.



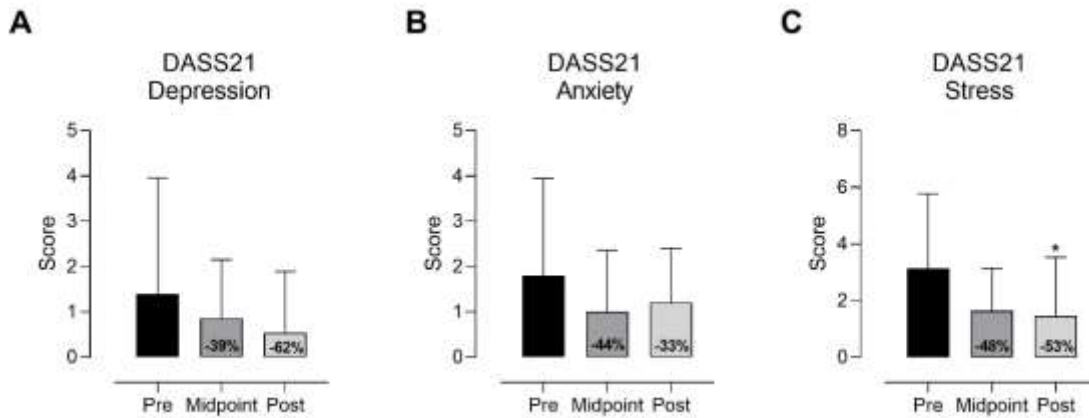
**Figure 5.** Self-reported sleep before, at midpoint, and after 30 days of daily NanoVi Exo® sessions.

## 2.2 DASS-21

The DASS-21 questionnaire evaluates self-reported levels of depression, anxiety, and stress, with higher scores indicating greater symptom severity. After 15 days of daily NanoVi Exo® sessions, participants reported a 39% reduction in depression scores, which further decreased to 62% after 30 days (Figure 6A).

Anxiety scores showed a 44% reduction at day 15, which was partially maintained with a 33% reduction at day 30 (Figure 6B).

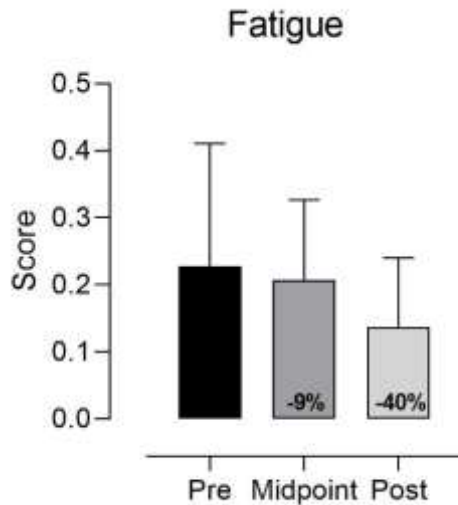
Stress scores decreased by 48% at the 15-day midpoint and reached a 53% reduction at the end of the 30-day period, a change that was statistically significant ( $p = 0.0316$ ; Figure 6C).



**Figure 6.** Depression, Anxiety and Stress scores before, at midpoint, and after 30 days of daily NanoVi Exo® sessions.

### 2.3 Fatigue Questionnaire

Participants completed a self-report questionnaire developed for the study to assess changes in fatigue. After 15 days of daily NanoVi sessions, participants reported a 9% reduction in fatigue scores, which increased to 40% after the intervention period, however it did not reach statistical significance (Figure 7A).



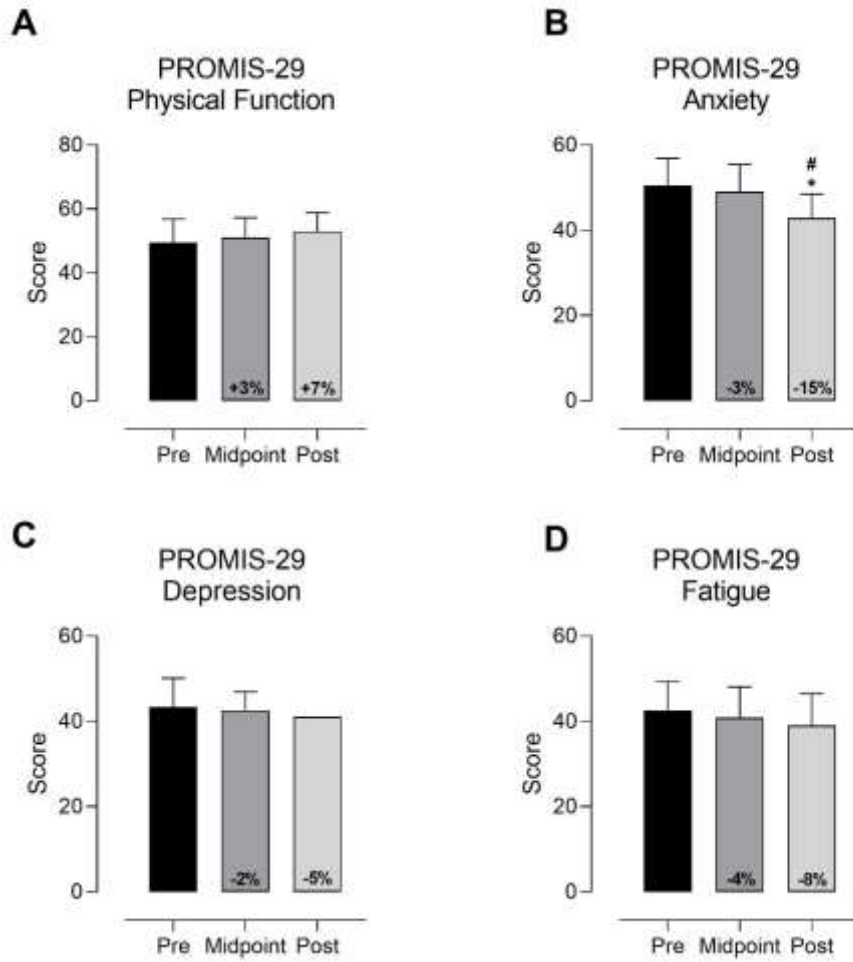
**Figure 7.** Fatigue scores before, at midpoint, and after 30 days of daily NanoVi Exo® sessions.

## 2.4. PROMIS-29 V2.0

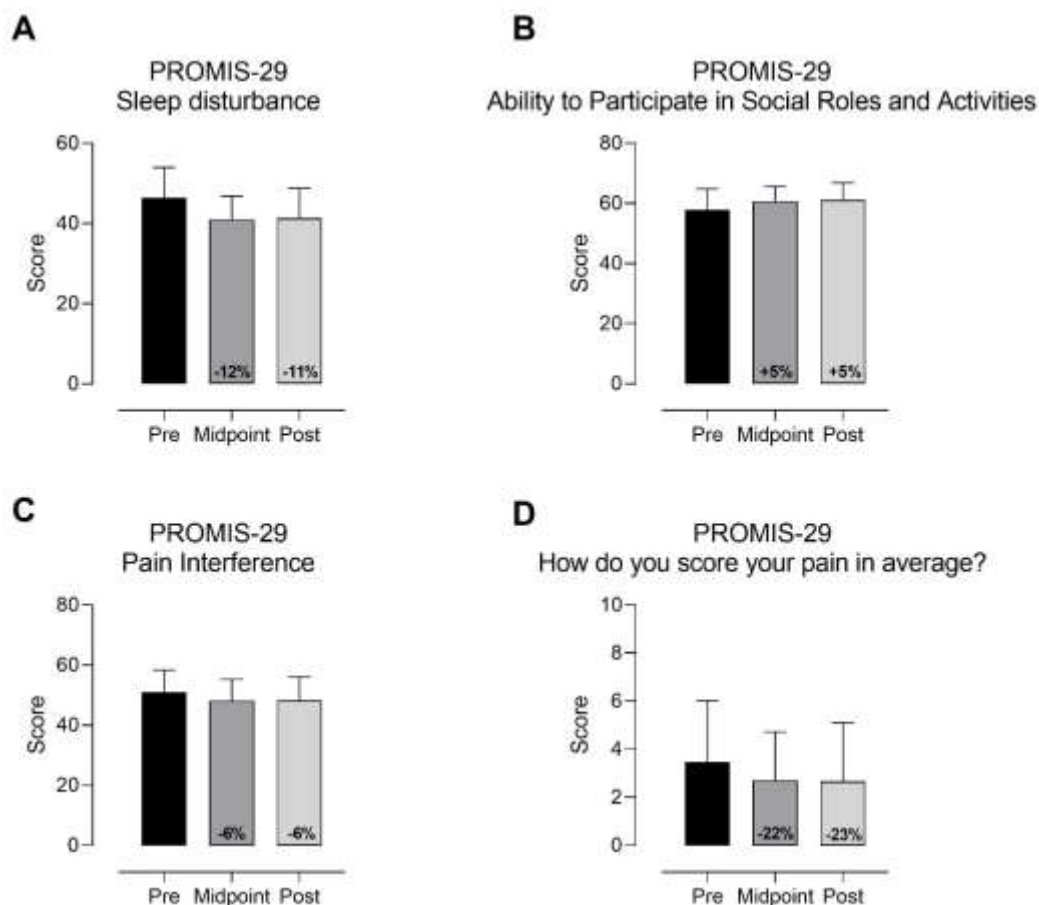
The PROMIS-29 v2.0 Profile assesses pain intensity using a 1–5 numeric rating scale and evaluates seven health domains—Physical Function, Fatigue, Pain Interference, Depressive Symptoms, Anxiety, Ability to Participate in Social Roles and Activities, and Sleep Disturbance—using four items per domain. For each domain, item responses were summed and converted into standardized T-scores for analysis (standard errors not included).

After 15 days of daily NanoVi Exo® sessions, participants reported a 3% improvement in Physical Function, which increased to 7% after 30 days (Figure 8A). Anxiety scores showed a 3% reduction at 15 days and a 15% reduction at 30 days, which was statistically significant compared to baseline values ( $p = 0.0167$ , Cohen's  $d = 1.28$ , large effect size) and midpoint values ( $p = 0.0495$ ; Figure 8B). Depressive symptoms decreased by 2% at 15 days and by 5% at 30 days (Figure 8C). Fatigue levels declined by 4% at 15 days and by 8% at 30 days (Figure 8D).

Sleep Disturbance was reduced by 12% at 15 days (Cohen's  $d = 0.81$ , large effect size) and by 11% at 30 days (Figure 9A). The Ability to Participate in Social Roles and Activities improved by 5% at both 15 and 30 days (Figure 9B). Pain Interference decreased by 6% at both 15 and 30 days (Figure 9C). Additionally, average pain intensity scores declined by 22% at 15 days, with this improvement sustained through the 30-day mark (Figure 9D).



**Figure 8.** PROMIS-29 scores before, at midpoint, and after 30 days of daily NanoVi Exo® sessions. \*  $p < 0.05$  compared to baseline. #  $p < 0.05$  compared to midpoint.



**Figure 9.** PROMIS-29 scores before, at midpoint, and after 30 days of daily NanoVi Exo® sessions.

**Table 2.** Descriptive Statistics of the self-reported outcomes.

| Sleep latency   |             |                    |                 |           |                  |
|-----------------|-------------|--------------------|-----------------|-----------|------------------|
| Group           | Mean ± SD   | Median (IQR)       | 95% CI (median) | Cohen's d | Effect size      |
| Pre (n=15)      | 0.22 ± 0.27 | 0.00 (0.00 – 0.50) | 0.00 – 0.50     | -         | -                |
| Midpoint (n=14) | 0.14 ± 0.21 | 0.00 (0.00 – 0.25) | 0.00 – 0.25     | 0.33      | Small - moderate |
| Post (n=15)     | 0.07 ± 0.20 | 0.00 (0.00 – 0.00) | 0.00 – 0.00     | 0.63      | Moderate-large   |
| Sleep duration  |             |                    |                 |           |                  |
| Group           | Mean ± SD   | Median (IQR)       | 95% CI (median) | Cohen's d | Effect size      |
| Pre (n=15)      | 7.15 ± 0.86 | 7.00 (6.30 – 8.00) | 6.30 – 8.00     | -         | -                |
| Midpoint (n=14) | 7.56 ± 1.04 | 8.00 (6.82 – 8.08) | 6.30 – 8.30     | 0.43      | Moderate         |
| Post (n=15)     | 7.19 ± 1.05 | 7.30 (7.00 – 8.00) | 7.00 – 8.00     | 0.04      | Very small       |

| <b>Difficulty falling asleep</b>                   |                  |                       |                        |                  |                    |
|--|------------------|-----------------------|------------------------|------------------|--------------------|
| <b>Group</b>                                       | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 0.28 ± 0.37      | 0.20 (0.00 – 0.40.00) | 0.00 – 0.40            | -                |                    |
| Midpoint (n=14)                                    | 0.10 ± 0.12      | 0.00 (0.00 – 0.20)    | 0.00 – 0.20            | 0.65             | Moderate – large   |
| Post (n=15)  | 0.14 ± 0.26      | 0.00 (0.00 – 0.20)    | 0.00 – 0.20            | 0.44             | Moderate           |
| <b>Daytime Sleepiness</b>                          |                  |                       |                        |                  |                    |
| <b>Group</b>                                       | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 0.18 ± 0.21      | 0.20 (0.00 – 0.33)    | 0.00 – 0.33            | -                |                    |
| Midpoint (n=14)                                    | 0.05 ± 0.11      | 0.00 (0.00 – 0.05)    | 0.00 – 0.20            | 0.78             | Moderate – large   |
| Post (n=15)  | 0.06 ± 0.11      | 0.00 (0.00 – 0.20)    | 0.00 – 0.20            | 0.72             | Moderate - large   |
| <b>Awakenings with trouble resleeping</b>          |                  |                       |                        |                  |                    |
| <b>Group</b>                                       | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 0.28 ± 0.26      | 0.20 (0.00 – 0.40)    | 0.00 – 0.40            | -                | -                  |
| Midpoint (n=14)                                    | 0.28 ± 0.36      | 0.20 (0.00 – 0.42)    | 0.00 – 0.67            | 0                | -                  |
| Post (n=15)  | 0.21 ± 0.28      | 0.20 (0.00 – 0.20)    | 0.00 – 0.20            | 0.26             | Small              |
| <b>Feeling drowsy/sleepy during the day</b>        |                  |                       |                        |                  |                    |
| <b>Group</b>                                       | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 0.21 ± 0.20      | 0.20 (0.00 – 0.40)    | 0.00 – 0.40            | -                | -                  |
| Midpoint (n=14)                                    | 0.09 ± 0.10      | 0.00 (0.00 – 0.20)    | 0.00 – 0.20            | 0.76             | Moderate – large   |
| Post (n=15)  | 0.09 ± 0.13      | 0.00 (0.00 – 0.20)    | 0.00 – 0.20            | 0.71             | Moderate - large   |
| <b>Shortness of breath or headache upon waking</b> |                  |                       |                        |                  |                    |
| <b>Group</b>                                       | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 0.08 ± 0.12      | 0.00 (0.00 – 0.20)    | 0.00 – 0.20            | -                | -                  |
| Midpoint (n=14)                                    | 0.05 ± 0.11      | 0.00 (0.00 – 0.05)    | 0.00 – 0.20            | 0.26             | Small              |
| Post (n=15)  | 0.04 ± 0.10      | 0.00 (0.00 – 0.00)    | 0.00 – 0.00            | 0.36             | Small - moderate   |
| <b>Snoring during sleep</b>                        |                  |                       |                        |                  |                    |
| <b>Group</b>                                       | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 0.35 ± 0.37      | 0.20 (0.00 – 0.60)    | 0.00 – 0.60            | -                | -                  |

| Midpoint (n=14)                 | 0.28 ± 0.30  | 0.20 (0.00 – 0.62)    | 0.00 – 0.67     | 0.21      | Small            |
|---------------------------------|--------------|-----------------------|-----------------|-----------|------------------|
| Post (n=15)                     | 0.27 ± 0.31  | 0.20 (0.00 – 0.40)    | 0.00 – 0.40     | 0.23      | Small            |
| DASS 21- Depression             |              |                       |                 |           |                  |
| Group                           | Mean ± SD    | Median (IQR)          | 95% CI (median) | Cohen's d | Effect size      |
| Pre (n=15)                      | 1.40 ± 2.56  | 1.00 (0.00 – 2.00)    | 0.00 – 2.00     | -         | -                |
| Midpoint (n=14)                 | 0.86 ± 1.30  | 0.00 (0.00 – 1.25)    | 0.00 – 2.00     | 0.27      | Small            |
| Post (n=15)                     | 0.53 ± 1.36  | 0.00 (0.00 – 0.00)    | 0.00 – 0.00     | 0.42      | Moderate         |
| DASS 21- Anxiety                |              |                       |                 |           |                  |
| Group                           | Mean ± SD    | Median (IQR)          | 95% CI (median) | Cohen's d | Effect size      |
| Pre (n=15)                      | 1.80 ± 2.15  | 1.00 (0.00 – 2.00)    | 0.00 – 2.00     | -         | -                |
| Midpoint (n=14)                 | 1.00 ± 1.36  | 1.00 (0.00 – 1.25)    | 0.00 – 2.00     | 0.44      | Moderate         |
| Post (n=15)                     | 1.20 ± 1.21  | 1.00 (0.00 – 2.00)    | 0.00 – 2.00     | 0.34      | Small - moderate |
| DASS 21- Stress                 |              |                       |                 |           |                  |
| Group                           | Mean ± SD    | Median (IQR)          | 95% CI (median) | Cohen's d | Effect size      |
| Pre (n=15)                      | 3.13 ± 2.64  | 2.00 (1.00 – 4.00)    | 1.00 – 4.00     | -         | -                |
| Midpoint (n=14)                 | 1.64 ± 1.50  | 1.00 (0.75 – 3.25)    | 0.00 – 4.00     | 0.69      | Moderate – large |
| Post (n=15)                     | 1.47 ± 2.06  | 1.00 (0.00 – 2.00)    | 0.00 – 2.00     | 0.70      | Moderate - large |
| Fatigue                         |              |                       |                 |           |                  |
| Group                           | Mean ± SD    | Median (IQR)          | 95% CI (mean)   | Cohen's d | Effect size      |
| Pre (n=15)                      | 0.23 ± 0.18  | 0.22 (0.06 – 0.38)    | 0.13 – 0.33     | -         | -                |
| Midpoint (n=14)                 | 0.21 ± 0.12  | 0.26 (0.09 – 0.29)    | 0.14 – 0.28     | 0.13      | Very small       |
| Post (n=15)                     | 0.14 ± 0.10  | 0.12 (0.04 – 0.24)    | 0.08 – 0.19     | 0.62      | Moderate - large |
| PROMIS – 29 – Physical Function |              |                       |                 |           |                  |
| Group                           | Mean ± SD    | Median (IQR)          | 95% CI (median) | Cohen's d | Effect size      |
| Pre (n=15)                      | 49.49 ± 7.33 | 48.00 (45.30 – 56.90) | 45.30 – 56.90   | -         | -                |
| Midpoint (n=14)                 | 51.08 ± 6.20 | 52.45 (44.83 – 56.90) | 43.40 – 56.90   | 0.23      | Small            |
| Post (n=15)                     | 53.03 ± 5.85 | 56.90 (48.00 – 56.90) | 48.00 – 56.90   | 0.53      | Moderate         |

| <b>PROMIS – 29 – Anxiety</b>   |                  |                       |                        |                  |                    |
|--|------------------|-----------------------|------------------------|------------------|--------------------|
| <b>Group</b>   | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 50.55 ± 6.39     | 51.20 (48.00 – 53.70) | 48.00 – 53.70          | -                | -                  |
| Midpoint (n=14)  | 49.12 ± 6.36     | 51.20 (40.30 – 55.80) | 40.30 – 55.80          | 0.22             | Small              |
| Post (n=15)  | 42.88 ± 5.61     | 40.30 (40.30 – 40.30) | 40.30 – 40.30          | 1.28             | Large              |
| <b>PROMIS – 29 – Depression</b>  |                  |                       |                        |                  |                    |
| <b>Group</b>   | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 43.37 ± 6.78     | 41.00 (41.00 – 41.00) | 41.00 – 41.00          | -                | -                  |
| Midpoint (n=14)  | 42.62 ± 4.33     | 41.00 (41.00 – 41.00) | 41.00 – 41.00          | 0.13             | Very small         |
| Post (n=15)  | 41.01 ± 0.03     | 41.00 (41.00 – 41.00) | 41.00 – 41.00          | 0.49             | Moderate           |
| <b>PROMIS – 29 – Fatigue</b>   |                  |                       |                        |                  |                    |
| <b>Group</b>   | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 42.59 ± 6.84     | 43.10 (33.70 – 48.60) | 33.70 – 48.60          | -                | -                  |
| Midpoint (n=14)  | 40.93 ± 7.21     | 41.40 (33.70 – 48.60) | 33.70 – 48.60          | 0.24             | Small              |
| Post (n=15)  | 39.00 ± 7.54     | 33.70 (33.70 – 43.10) | 33.70 – 43.10          | 0.50             | Moderate           |
| <b>PROMIS – 29 – Sleep disturbance</b>                                   |                  |                       |                        |                  |                    |
| <b>Group</b>   | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 46.47 ± 7.54     | 50.50 (37.50 – 52.40) | 37.50 – 52.40          | -                | -                  |
| Midpoint (n=14)  | 41.04 ± 5.83     | 41.10 (36.13 – 46.20) | 32.00 – 46.20          | 0.81             | Large              |
| Post (n=15)  | 41.26 ± 7.47     | 43.80 (32.00 – 43.80) | 32.00 – 43.80          | 0.69             | Moderate - large   |
| <b>PROMIS-29 – Ability to Participate in Social Roles and Activities</b> |                  |                       |                        |                  |                    |
| <b>Group</b>   | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 57.92 ± 6.95     | 58.30 (53.70 – 64.20) | 53.70 – 64.20          | -                | -                  |
| Midpoint (n=14)  | 60.80 ± 4.93     | 64.20 (55.28 – 64.20) | 53.70 – 64.20          | 0.48             | Moderate           |
| Post (n=15)  | 61.06 ± 5.79     | 64.20 (55.80 – 64.20) | 55.80 – 64.20          | 0.49             | Moderate           |
| <b>PROMIS-29 – Pain Interference</b>                                     |                  |                       |                        |                  |                    |
| <b>Group</b>   | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)   | 51.17 ± 7.25     | 49.60 (41.60 – 57.10) | 41.60 – 57.10          | -                | -                  |

| Midpoint (n=14)                       | 48.11 ± 7.08     | 45.60 (41.60 – 54.33) | 41.60 – 55.60          | 0.43             | Moderate           |
|---------------------------------------|------------------|-----------------------|------------------------|------------------|--------------------|
| Post (n=15)                           | 48.23 ± 7.88     | 41.60 (41.60 – 55.60) | 41.60 – 55.60          | 0.39             | Small – moderate   |
| <b>PROMIS-29 – Average Pain Score</b> |                  |                       |                        |                  |                    |
| <b>Group</b>                          | <b>Mean ± SD</b> | <b>Median (IQR)</b>   | <b>95% CI (median)</b> | <b>Cohen's d</b> | <b>Effect size</b> |
| Pre (n=15)                            | 3.47 ± 2.56      | 3.00 (1.00 – 5.00)    | 1.00 – 5.00            | -                | -                  |
| Midpoint (n=14)                       | 2.71 ± 2.02      | 3.00 (0.75 – 4.00)    | 0.00 – 4.00            | 0.33             | Small – moderate   |
| Post (n=15)                           | 2.67 ± 2.44      | 2.00 (1.00 – 4.00)    | 1.00 – 4.00            | 0.32             | Small – moderate   |

n = number of participants; CI = 95% Confidence Interval; SD = Standard Deviation; IQR = Interquartile Range. For non-parametric data, values are presented as 95% CI of the median. For parametric data, values are presented as 95% CI of the mean.

### 3. Conclusion

After 30 days of daily NanoVi Exo® sessions, participants demonstrated multidimensional improvements across both physiological and self-reported wellness indicators. While physiological parameters did not reach statistical significance, favorable trends were observed in measures of autonomic nervous system function and cerebral oxygenation, including increases in HRV indices and cerebral blood flow metrics.

More pronounced effects were seen in self-reported outcomes. Participants reported improvements in sleep quality, including reductions in sleep latency, nighttime awakenings, and daytime sleepiness. Emotional well-being also improved, with reductions in self-reported stress, anxiety, and depressive symptoms. Fatigue levels decreased over time, and participants reported gains in physical function and social role participation, along with reductions in pain interference and intensity.

Taken together, the findings suggest that daily use of the NanoVi Exo® device may contribute to enhanced sleep quality, emotional resilience, fatigue perception, and overall well-being, with the strongest effects observed in self-reported psychological and functional domains.

## ABOUT US

At Scientifica Consulting, we ignite innovation and power success in health and wellness. With over a decade of experience, we blend science with strategy to help companies excel, ensuring FDA and FTC compliance every step of the way. Our team of experts— professors, scientists, and researchers—guides you from idea to market, turning possibilities into breakthrough products. Let's shape the future together!

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