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## Sleep and Function in Patients with Multiple Sclerosis

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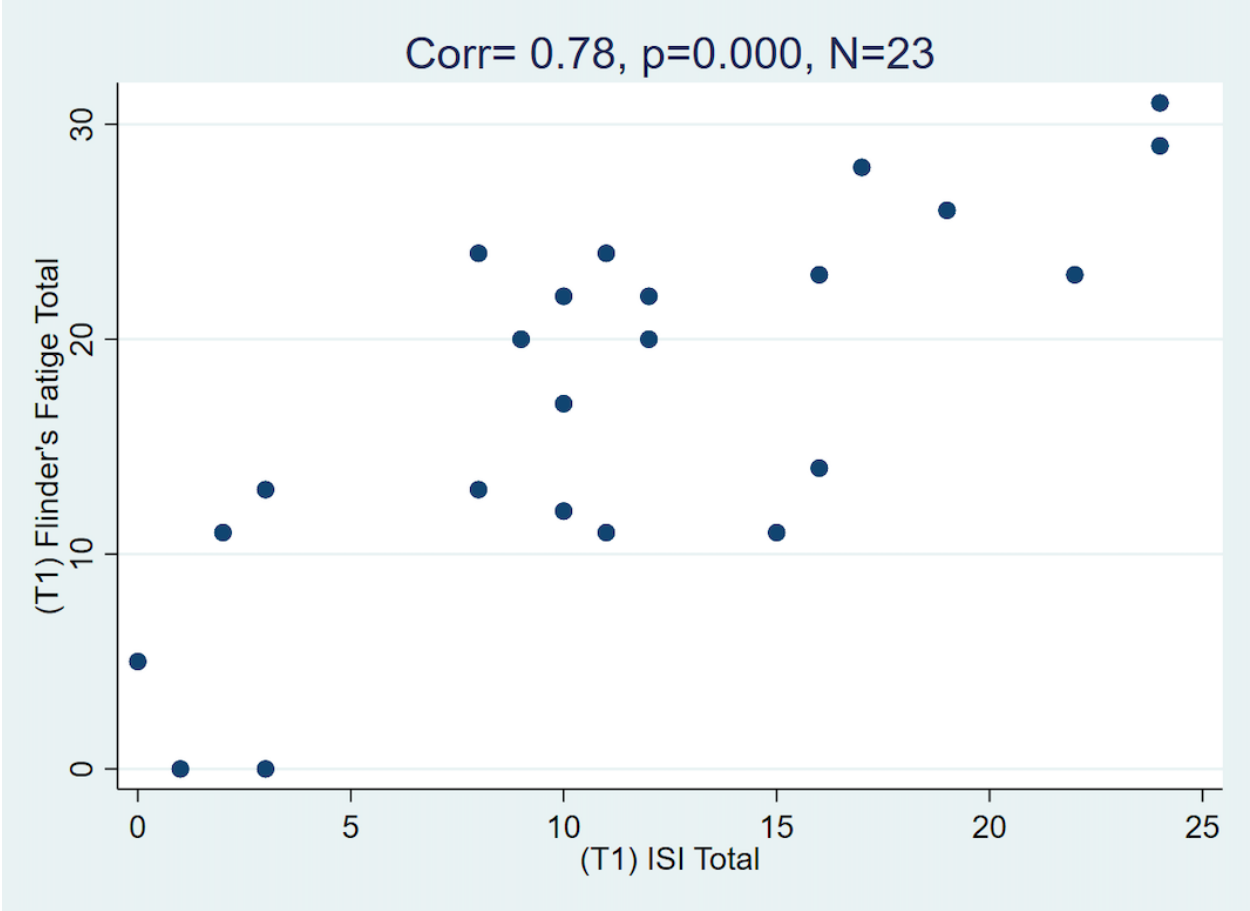
**Introduction:** Fatigue is a core symptom of Multiple Sclerosis (MS) and impairs function and quality of life in this patient population. Studies show that sleep-disordered breathing is also common in persons with MS and may exacerbate fatigue symptoms. Within a larger study of patients with spinal cord injuries and disorders, we evaluated the relationships among sleep-disordered breathing (SDB) severity, sleep quality, and functional outcomes in patients with MS. Our objective was to examine the impact of SDB severity on the severity of fatigue and functional impairment in this population.

**Methods:** Twenty-five subjects (average age=57(11), min=35, max=79; 80% male; average AHI=27(20) min=3, max=70; and 67% with AHI  $\geq$  15) 24 completed in-laboratory polysomnography (PSG) to measure apnea-hypopnea index (AHI) and sleep efficiency (SE) and questionnaires about sleep and function including: Craig Handicap Assessment and Reporting Technique (CHART), Insomnia Severity Index (ISI), Pittsburg Sleep Quality Index (PSQI), Epworth Sleepiness Scale (ESS), Flinders Fatigue Scale (FFS), PHQ-9 depression scale (excluding sleep item), Generalized Anxiety Disorder-7 (GAD-7), Brief Pain Inventory (BPI) and World Health Organization Quality of Life . Relationships between sleep measures (AHI and SE from PSG, ISI and PSQI) and measure of daytime function (ESS, FSS, SCIM III-SR, PHQ-9, GAD-7, and WHOQOL) were assessed by bivariate correlation.

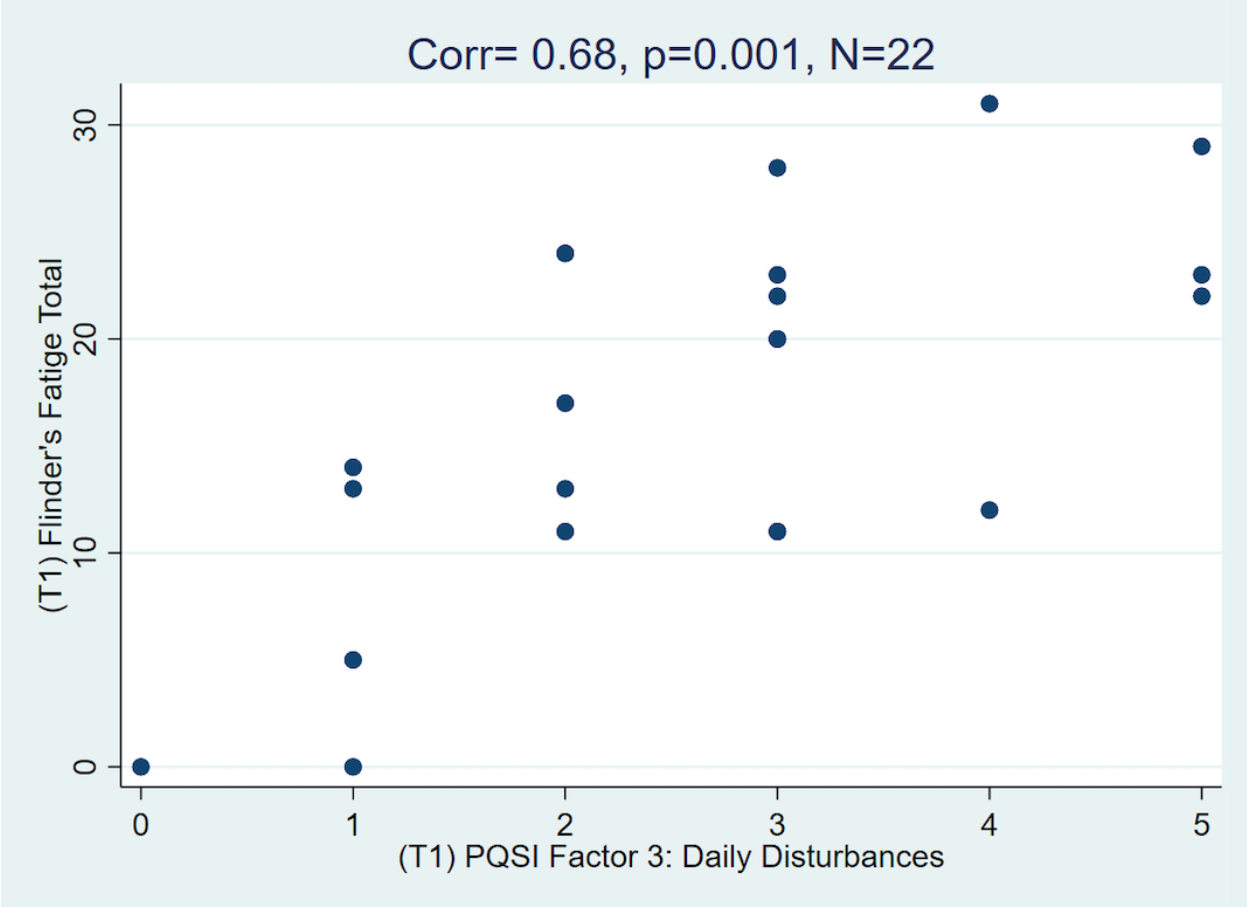
**Results:** At the baseline study visit, we assessed participant's daytime sleepiness, fatigue, sleep quality, depression and anxiety. The mean scores on questionnaires are as follows: ESS was 8.0(5.6), ISI was 11.5(6.7), PSQI was 9.3(4.4), FFS was 17.3(8.7), BPI severity was 3.4 (3.12), BPI interference was 3.5 (3.5), PHQ-9 was 7.3(5.8). **There were significant relationships between ISI and FSS ( $r=0.78$ ,  $p=0.000$ ), PSQI and FFS ( $r=0.68$ ,  $p=0.001$ ), as well as ISI and WHOQOL( $r=-0.64$   $p=0.001$ ). In terms of relationships between daytime and nighttime measurements: total AHI had a weak positive correlation with CHART physical independence ( $r=-0.49$ ,  $p=0.016$ ), Sleep efficiency has a weak positive correlation with quality of life ( $r=0.43$ ,  $p=0.042$ ) and sleep efficiency is weakly inversely correlated with fatigue ( $r=-0.45$ ,  $p=0.041$ ).**

**Conclusion:** Our data suggests that there is a strong association between the severity of insomnia and the severity of fatigue and depression in MS patients, a moderately strong correlation between reported sleep disturbances as fatigue, and a moderate association between severity of insomnia and reported quality of life. Although twenty-three out of twenty-four subjects in this study have SDB, severity of SDB had a weaker correlation with daytime measures such as fatigue, quality of life, and physical independence.

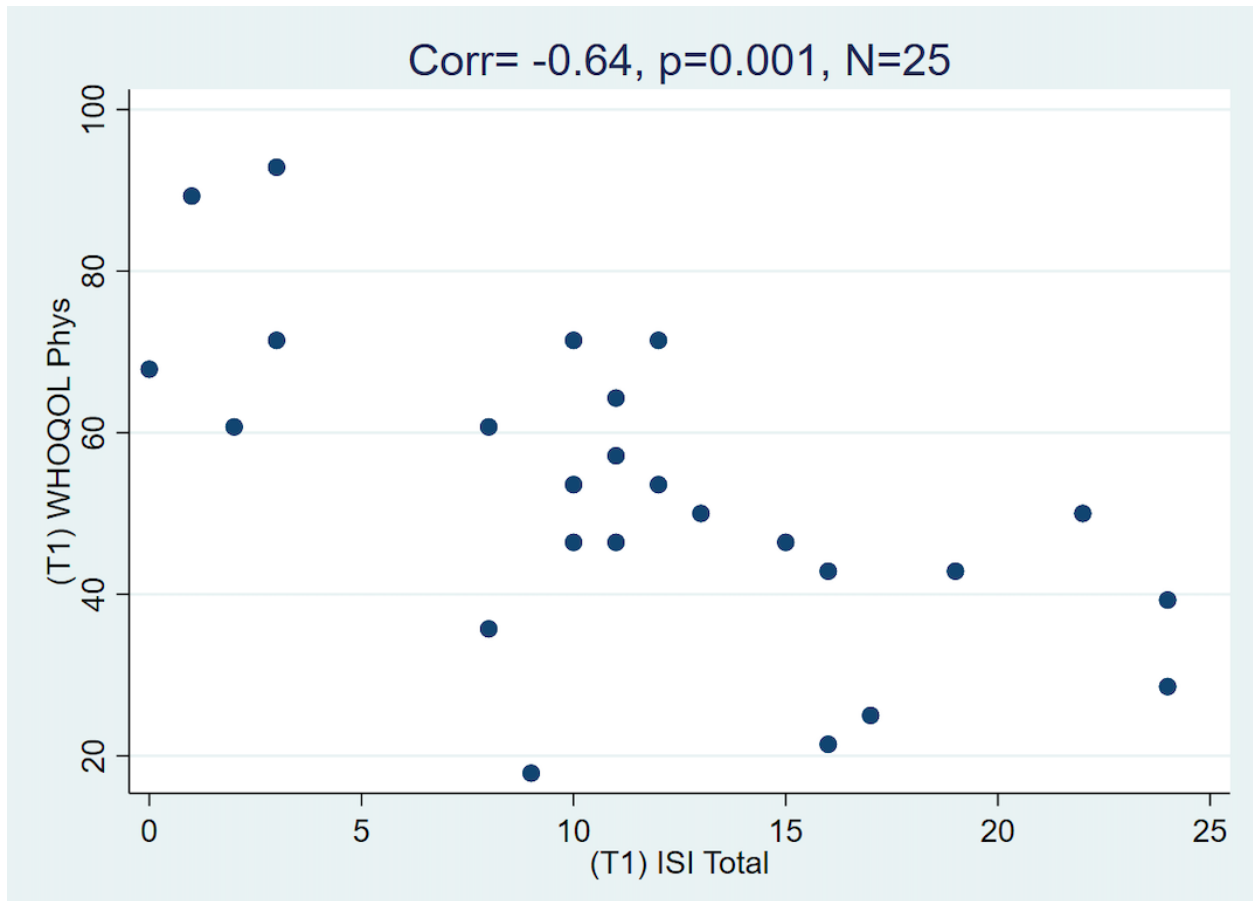
Given that fatigue and depression are common among MS patients and negatively impact quality of life, treatment of insomnia and lessening of sleep disturbances through sleep hygiene and/or SDB treatment may improve patient outcomes.



**Figure 1:** Higher insomnia severity index scores are associated with higher Flinders fatigue scales scores (strong correlation).



**Figure 2:** Increased daily sleep disturbances on PSQI are associated with higher Flinders fatigue scales scores (moderate-strong correlation).



**Figure 3:** An increase in subjective insomnia scores is inversely correlated with quality of life (moderate correlation).