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Determinants of Pulmonary Function in Spinal Cord Injury: Shifting from Acute to Subacute Stage

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Objective

- The impairment of respiratory muscles due to spinal cord injury (SCI) causes various pulmonary dysfunction and complications.
- Although respiratory complications are a leading cause of morbidity and mortality, existing literature focuses primarily on the chronic stage.
- This study sought to identify and compare the determinants of key spirometric parameters—forced vital capacity (FVC), forced expiratory volume in one second (FEV_1), and peak expiratory flow (PEF)—during the acute (2 weeks to 3 months) and subacute (3 to 6 months) post-injury phases.

Methods

- We conducted a cross-sectional analysis of 1,510 patients with SCI admitted to a single rehabilitation center between 1997 and 2022.
- After excluding patients with incomplete data, high cervical injuries (C1–C2), or age <19 years, 347 patients (Acute: n=180; Subacute: n=167) were included.
- Multivariable regression analyses were performed using FVC (% predicted), FEV_1 (% predicted), and PEF as dependent variables.
-]Independent variables included body mass index (BMI), neurological level of injury (NLI), injury completeness (motor-complete [AIS A–B] vs. motor-incomplete [AIS C–D]), and duration since injury.

Results

- The determinants of pulmonary function exhibited distinct patterns between acute and subacute phases of spinal cord injury.

Figure 1. Changes in Determinants of FVC (% predicted) Over Time

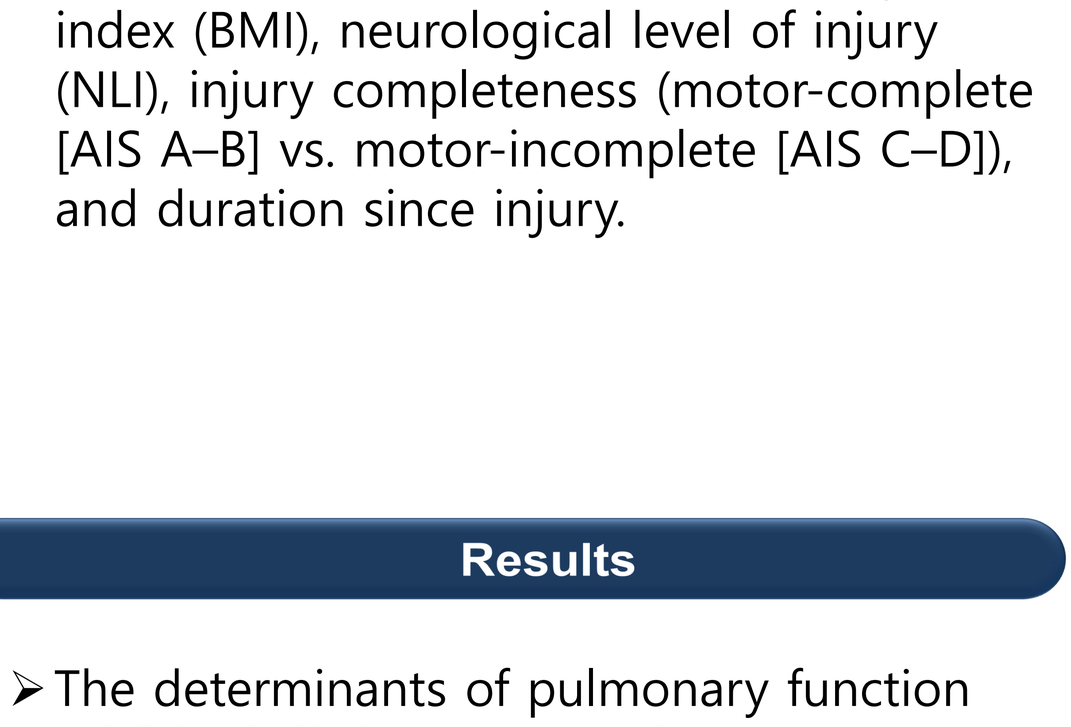


Figure 2. Changes in Determinants of FEV1 (% predicted) Over Time

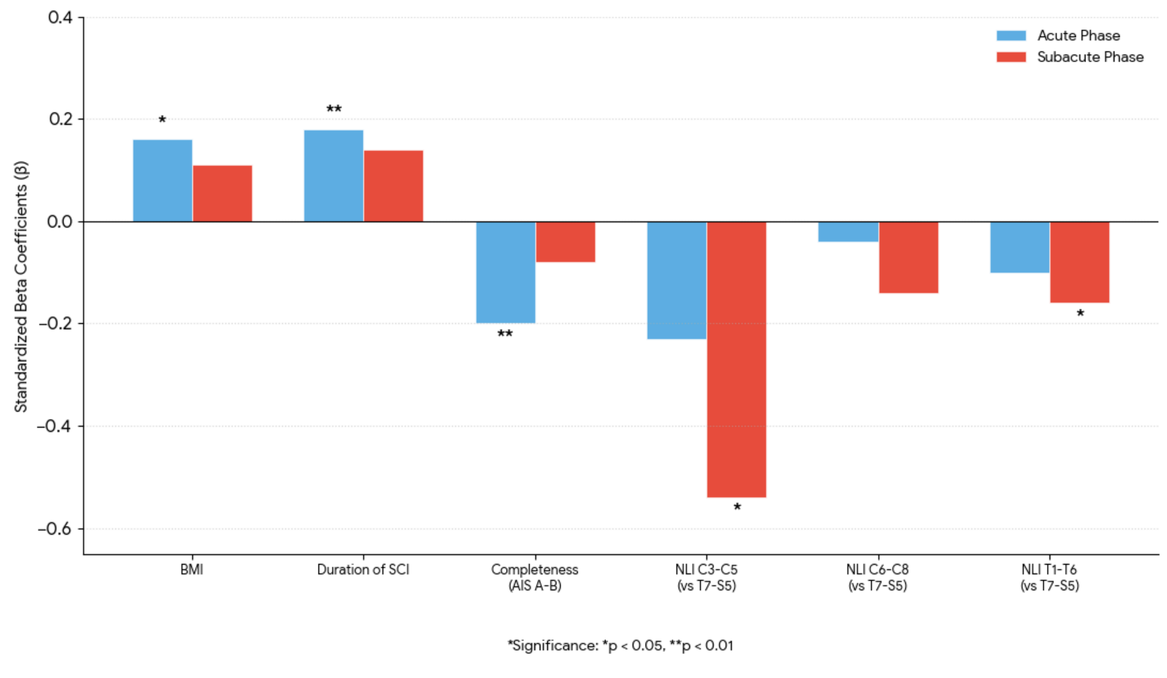
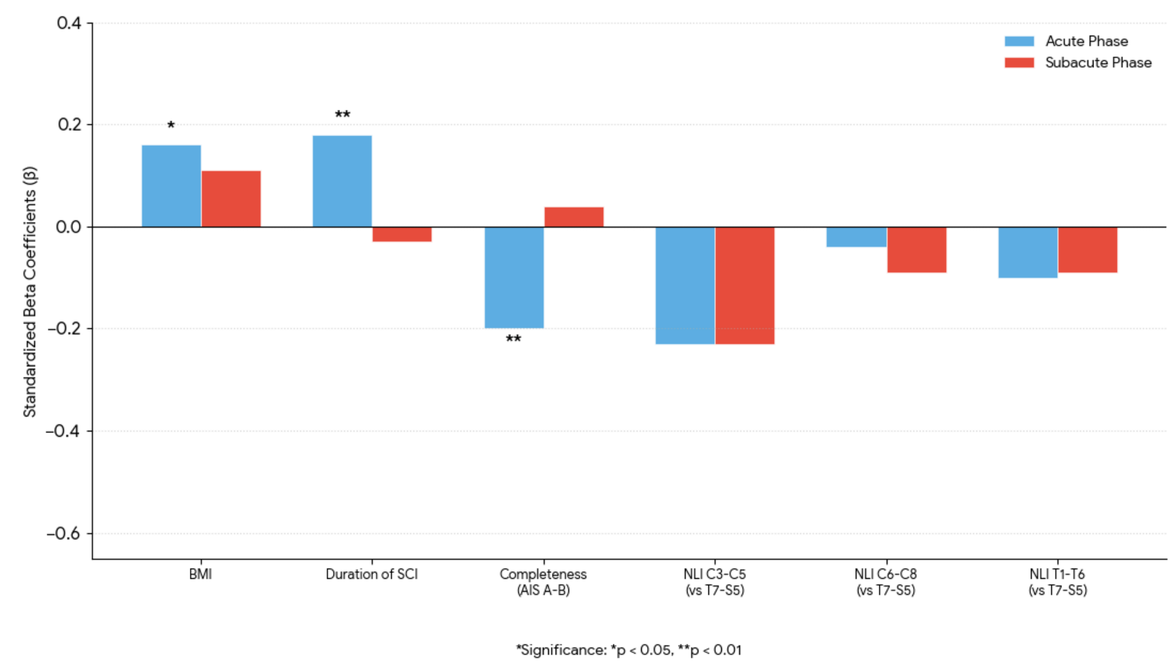


Figure 3. Changes in Determinants of Peak Flow (PEF) Over Time



- In the acute stage, higher BMI (FVC β = 0.21, p = 0.001; FEV_1 β = 0.16, p = 0.016; PEF β = 0.16, p = 0.004) and longer duration since injury (FVC β = 0.15, p = 0.017; FEV_1 β = 0.18, p = 0.007; PEF β = 0.18, p = 0.007) were positive predictors associated with improved pulmonary function across all parameters.
- Conversely, Motor-complete status (FVC β = -0.18, p = 0.005; FEV_1 β = -0.20, p = 0.004; PEF β = -0.20, p = 0.004) and the T1–T6 neurological level (FVC β = -0.18, p = 0.025) were significantly associated with lower pulmonary function values.
- In the subacute stage, NLI was the predominant determinant with the C3–C5 (FVC β = -0.54, p = 0.016; FEV_1 β = -0.54, p = 0.022) and T1–T6 (FVC β = -0.26, p = 0.001; FEV_1 β = -0.16, p = 0.046) groups demonstrating significantly greater reductions in pulmonary function relative to the T7–S5 reference group.

Conclusion

- The primary determinants of pulmonary function shift from anthropometric factors and injury completeness in the acute phase to the neurological level of injury in the subacute phase.
- Understanding these shifting determinants is clinically vital for predicting the recovery trajectory and identifying high-risk patients who require intensive respiratory monitoring.
- Further longitudinal studies are warranted to validate the impact of these early-stage determinants on long-term respiratory outcomes and to refine predictive models for patients with SCI.

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