

## Letter: Assessing Frailty in Neurosurgical Patients: Less is not Always More. Is There Any Construct Validity Left in the Modified Frailty Index?

To the Editor:

The geriatric population is the fastest-growing segment of the US population, which accounts for more than 20% of all hospital admissions and represents a challenging patient group to treat in surgical centers.<sup>1</sup> Early identification of vulnerable, or frail, patients is essential in the preoperative phase and may improve outcome.<sup>2</sup> Frailty, more than the mere summum of physical consequences of disease and disability, inherently implies psychological burden. Therefore, operationalizing frailty is a challenging and controversial endeavor, and most methods rely on creating a *frailty index* (FI), by counting deficits in health, either symptoms, signs, diseases, disabilities, or laboratory parameters. Examples of such scores include the recently validated preoperative Frailty Index (pFI)<sup>3</sup>, the Modified Frailty Index (mFI)-11 and mFI-5.<sup>3</sup> We aim to reflect on the validation efforts of the mFIs and hypothesize that the fundamental changes that they have undergone, driven by convenience, not clinical insight, have made them irrelevant.

The Canadian Study of Health and Aging (CHSA FI) developed a FI including 70 factors, which showed a robust association with mortality and adverse outcomes.<sup>4</sup> Given the scale's complexity and difficulties related to data acquisition,<sup>5</sup> these risk factors were mapped to 11 items comprising 16 variables present in the American College of Surgeons National Surgical Quality Improvement Program (ACS NSQIP) database. The resulting 11-factor "modified" frailty index (mFI-11) has shown a strong association with morbidity and mortality across all surgical specialties.<sup>6</sup> After 2012, 11 of the 16 variables were no longer reported in the database, and thus the mFI-5 was defined.<sup>7</sup> The remaining comorbidities are congestive heart failure, diabetes mellitus, chronic obstructive pulmonary disease or current pneumonia, hypertension requiring medication, and fully or partially dependent functional status.

"Frailty is defined as a syndrome of decreased physiological reserve and resistance to stressors, which results in increased vulnerability to poor health outcomes, worsening mobility and disability, hospitalizations, and death."<sup>1</sup> A commentary to one of the studies<sup>7</sup> aiming to compare the mFI-11 and mFI-5 begins with the statement that most surgeons are likely not able to define frailty, but they know it when they see it. There is a partially abstract, partially subjective, psychological dimension of frailty, as depicted by factors included in the original FI, but not in the reduced versions: feelings of depression, mood problems, tiredness, restlessness, or loneliness, health decline in the past year, or the self-rating of health.<sup>5</sup> Whether these aspects are of essence or not is unclear—the modified FIs were never

prospectively validated against the original 70-item FI. Most of the validation efforts focused on the predictive validity of the mFI, while ignoring construct validity, ie, the degree to which the instrument measures the theoretical constructs that it was intended to measure. It is highly debatable whether simply having 2 of the 5 comorbidities, eg, hypertension and diabetes, included in the mFI-5 makes a patient "severely frail", according to the definition stated above.

The validation efforts were carried out for a variety of neurosurgical subspecialties and surgical specialties. Examples include neurosurgical oncology<sup>8,9</sup> or spine<sup>10</sup>, but also orthopedics<sup>11</sup> and trauma.<sup>12</sup> Several of the validation studies included cohorts in excess of 100 000 patients.<sup>7,11</sup> The validation methodologies, however, were not uniform. Some investigators<sup>9</sup> dichotomized the mFI, while others treated it as a continuous variable.<sup>7,11</sup> It was often used as a standardized measure to account for missing values.<sup>7</sup> This strategy might overestimate the risk of adverse outcome of patients with missing values, by equivocating the effect of 2 out of 3 comorbidities (2 missing) to that of 3 out of the 5 comorbidities.

When looking at the absolute numbers, the prevalence of hypertension needing treatment for both the mFI-11 and the mFI-5 was almost twice the prevalence of all the other comorbidities added together.<sup>7</sup> It appears thus that most patients classified as frail had hypertension and one more comorbidity. The various comorbidities in the mFI-5 are not weighted, which makes a patient with a fully dependent functional status less frail, according to the score, than a patient with hypertension and diabetes. Despite these issues, however, the mFI-5 still shows a high association with mortality, complications and readmission.<sup>7,9,11</sup> Whether the association is causal, however, despite the large number of patients included, and not the result of operational and residual confounding has not been satisfactorily proven and this issue has not been properly addressed in any of the papers. Without inferring causality, the clinical relevance of any scale is low.

Despite their origin, the 70-item CHSA FI, both mFIs were constructed and trimmed down based on the availability of variables in a database and not based on new research or clinical/methodological insights. Whether the mFI-5 still represents a measure of "frailty" as it was originally intended is highly disputable. According to the validation studies carried out so far, one could conclude in broad strokes that "a patient with hypertension and another comorbidity has a higher risk of mortality and readmission".

Reducing the number of variables in a prognostic scale in order to make it more clinically appealing is an effort that should be encouraged and applauded. The variable selection, however, should be driven by clinical and robust methodological insights and any measurement instrument should stay true to its original designation. Frailty does not only mean comorbidity and

efforts to translate this complex concept into a clinically applicable scale should evolve.


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