

Conflating Disability, Frailty, and Multimorbidity in Adult Spinal Deformity Patients

Seeking a Continuous Measure of Vulnerability

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Study Design. Retrospective cohort study.

Objective. To examine the degree of overlap between disability, multimorbidity, and frailty in a cohort of ASD patients.

Summary of Background Data. Frailty is a popular topic in spine research, as it is a reported risk factor for poor outcomes. Disability, multimorbidity, and frailty can coexist, sometimes causing or exacerbating one another. It is important to distinguish these conditions for perioperative optimization and to guide research initiatives.

Methods. A multicenter registry of ASD patients was queried for baseline data regarding frailty, as measured by the Edmonton Frail Scale, disability, as measured by the Oswestry Disability Index, and multimorbidity, as measured by the Charlson comorbidity index. The relationships between these measures and both chronological and biological age (PhenoAge) were explored. Exploratory factor analysis (EFA) examined areas of overlap between these diagnoses.

Results. There were 861 patients contributing data, mostly female (68%), most undergoing primary surgery at a median age of 66 years [interquartile range (55.1–71.6)], with 6% classified as “Frail.” Chronological and PhenoAge showed weak to moderate associations with disability and frailty, though PhenoAge was stronger. There was no evidence of distinct clusters, rather a continuity of condition severity. EFA found overlap between subjective and objective measures of disability, function, and frailty.

Conclusions. Frailty was rare (6%) in this multicenter cohort of patients. Conflation of disability and frailty is a real risk due to overlap in measures of both conditions. Disability and frailty do not form discrete categories but rather exist along a continuum, underscoring the need to abandon categorical labels in favor of continuous measures for both clinical assessment and research settings.

Key Words: adult spinal deformity, frailty, disability, Oswestry, biomarker, Edmonton

(*Spine* 2026;51:343–353)

Received for publication June 2, 2025; accepted August 4, 2025.

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The authors report no conflicts of interest.

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DOI: 10.1097/BRS.0000000000005508

Adult spinal deformity (ASD) surgeries are increasing in prevalence with an aging population seeking higher quality of life.¹ When symptomatic, the disability attributed to ASD can be severe, leading patients to undergo surgery. In general, ASD surgeries on older adults are viewed as “higher risk” due to the complex, invasive surgeries required and a consensus that older age means less suited for invasive surgery.² However, the literature is mixed regarding the absolute risk of surgery in this patient population, confounding decision-making by patients and surgeons alike.³ As we move to a precision-medicine approach to spinal deformity care, improved prediction models are needed to inform this decision-making process.

Risk prediction models will use baseline data, including patient demographic, radiographic, and planned surgical data. Chronological age is well studied and is commonly categorized by threshold values, for example, “ages older than 60.”⁴ More recent work suggests that chronological age is a poor biomarker, not accounting for the underlying physiological state.⁵ There is increasing interest in frailty as a risk factor for poor outcomes in ASD surgery, particularly with the aging patient population.⁶ Frailty is defined as an accumulation of health deficits putting an individual at risk for adverse health events, including disability and death, and is directly related to increasing age. Thus, frailty is an independent cause of disability, although an entity unique in and of itself. Increasing age is associated with

multimorbidity, an accumulation of two or more chronic diseases and the resulting phenotype, as well as an increasing risk of disability. Thus, these three composite conditions are unique though intrinsically interconnected.⁷⁻⁹

Multiple efforts exist to distinguish frailty from multimorbidity and disability.^{8,10} Fried suggests that multimorbidity is “the aggregation of clinically manifest diseases present in an individual”, whereas frailty is “the aggregate of subclinical losses of reserve across multiple physiological systems.” A clear understanding of these distinct processes is needed to improve preoperative prediction and optimization of ASD patients. The purpose of this paper is to review the prevalence and relationships of these three syndromes in a cohort of complex ASD patients.

METHODS

A multicenter registry (Clinicaltrials.gov ID NCT04194138) of patients treated for ASD was queried for patients enrolled from 2018 to 2024. Institutional review board approval was obtained at all participating sites. All patients enrolled in the registry were at least 18 years of age and had a diagnosis of adult congenital, degenerative, idiopathic, or iatrogenic thoracolumbar spinal deformity with plan for operative treatment. For

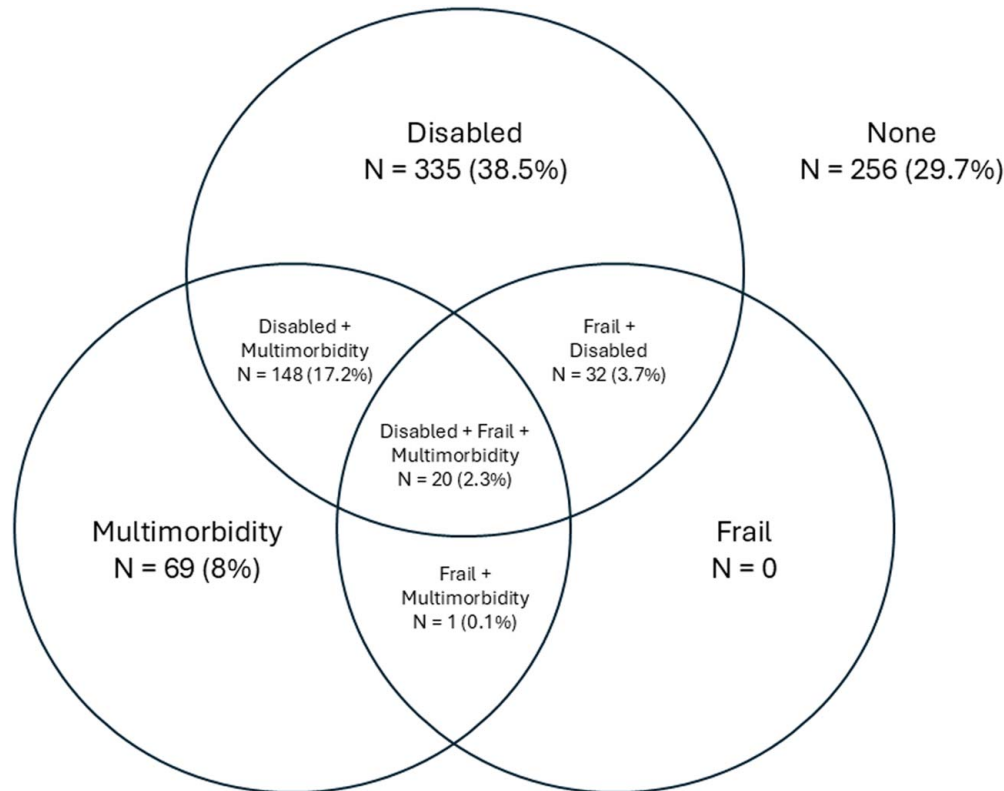


Figure 1. Venn diagram showing the overlap of categories when classified by disability, multimorbidity, and frailty. Those not meeting any threshold for inclusion were termed “None.”

TABLE 1. Demographic Data, Patient-Reported Outcomes Measures, and Radiographic Measures

	None	Disabled	Multimorbidity	Frail	Disabled + Multimorbidity	Disabled + Frail	Multimorbidity + Frail	Disabled + Multimorbidity + Frail	P
Chronological age	53.0 (18.6)	62.0 (13.4)	67.3 (10.7)	—	69.1 (8.6)	62.7 (11.8)	64.4 (—)	63.6 (10.9)	<0.001
DNAm PhenoAge (N = 208)	39.0 (19.5)	54.3 (16.4)	61.9 (17.3)	—	66.8 (17.3)	58.0 (11.6)	—	65.5 (23.2)	<0.001
Female sex, n (%)	174 (68)	241 (72)	42 (61)	—	90 (61)	20 (62.5)	1 (100)	16 (80)	0.13
Race, n (%)	223 (87)	312 (93)	69 (100)	—	141 (95)	27 (84)	1 (100)	12 (60)	<0.001
Caucasian, n (%)	13 (5)	9 (2.7)	0	—	4 (2.7)	3 (9.4)	0	4 (20)	
African American, n (%)	10 (4)	3 (1)	0	—	2 (1.4)	1 (3.1)	0	0	
Asian, n (%)	1 (0.4)	0	0	—	0	0	0	0	
Native American, n (%)	3 (1)	3 (1)	0	—	0	0	0	1 (5)	
Pacific Island, n (%)	6 (2)	2 (1)	0	—	1 (1)	1 (3.1)	0	2 (10)	
Other/NA, n (%)		5 (2)		—					
Height (cm)	164.6 (10.1)	165.1 (10.5)	163.5 (9.6)	—	166.4 (10.6)	165.7 (10.8)	154.9 (—)	159.8 (11.2)	0.10
Weight (kg)	69.4 (15.5)	77.3 (19.6)	72.7 (17.7)	—	79.5 (19.2)	79.5 (19.5)	51.7 (—)	82.7 (16.0)	<0.001
Body mass index	25.5 (4.7)	28.2 (5.8)	27.0 (5.4)	—	28.5 (5.6)	28.7 (5.4)	21.5 (—)	32.3 (4.9)	<0.001
PROMIS-Anxiety	53.7 (8.3)	57.4 (9.2)	51.5 (7.5)	—	55.0 (8.7)	62.9 (6.2)	84.9 (—)	61.3 (7.0)	<0.001
PROMIS-Depression	48.7 (8.0)	54.2 (9.1)	48/6 (8.1)	—	52.1 (8.5)	61.8 (7.0)	78.1 (—)	59.9 (8.4)	<0.001
PROMIS-Pain Interference	57.9 (6.3)	67.3 (5.9)	59.1 (6.8)	—	67.1 (4.7)	71.6 (5.5)	52.8 (—)	67.8 (6.2)	<0.001
PROMIS-Physical Function	41.3 (7.1)	31.7 (5.2)	38.9 (6.5)	—	31.9 (4.7)	27.7 (4.6)	31.8 (—)	27.8 (4.9)	<0.001
PROMIS-Social Satisfaction	48.6 (8.1)	38.9 (7.0)	46.1 (7.5)	—	38.7 (6.7)	35.1 (5.5)	35.1 (—)	36.3 (5.4)	<0.001
DSA				—					
PROMIS-Social Satisfaction Roles	47.1 (8.1)	36.8 (6.7)	44.3 (7.4)	—	23.7 (7.4)	22.7 (6.9)	45.8 (—)	21.5(5.3)	<0.001
VR-12 PCS	38.9 (10.1)	23.9 (7.2)	34.7 (9.6)	—	23.7 (7.4)	22.7 (6.9)	45.8 (—)	21.5 (5.3)	<0.001
VR-12 MCS	52.2 (9.8)	44.7 (13.6)	54.2 (10.7)	—	46.6 (12.3)	22.7 (6.9)	45.8 (—)	21.5 (5.3)	< > 001
Maximum coronal Cobb	46.1 (24.9)	34.1 (21.0)	44.4 (21.3)	—	29.7 (19.8)	29.9 (22.8)	34.2 (—)	21.4 (16.0)	<0.001
L1 pelvic angle mismatch	3.1 (8.1)	6.1 (8.2)	4.8 (9.0)	—	7.3 (8.1)	10.7 (8.7)	18.6 (—)	10.7 (9.1)	<0.001
Pelvic incidence – lumbar lordosis mismatch	9.8 (26.2)	19.3 (21.3)	15.2 (25.7)	—	22.9 (19.3)	26.7 (21.5)	48.6 (—)	29.1 (24.5)	<0.001

Continuous measures are compared with a one-way ANOVA and Bonferroni correction. Categorical measures are compared with a χ^2 test.

TABLE 2. Rotated Factor Loadings for Exploratory Factor Analysis of Disability (Owestry Disability Index), Frailty (Edmonton Frail Scale), and Multimorbidity

Variable	Factor 1: Disability (ODI)	Factor 2: Frailty (Edmonton Frail Scale)	Factor 3: Multimorbidity
ODI Q10: Employment/homemaking	0.790		
ODI Q8: Social life	0.789		
ODI Q9: Traveling	0.721		
ODI Q2: Personal care	0.699		
ODI Q4: Walking	0.694		
ODI Q3: Lifting	0.680		
EFS Q: Functional performance	0.599	0.445	
EFS Q: Functional independence	0.591		
ODI Q7: Sleeping	0.577		
Timed walk (3 m, s)	0.564	0.473	-0.339
ODI Q6: Standing	0.564		
ODI Q1: Pain intensity	0.540		
EFS Q: Medication use	0.498		
ODI Q5: Sitting	0.460	-0.326	

Loadings ≥ 0.4 are considered meaningful. Items are listed on descending order by factor 1.

this study of complex thoracolumbar deformities, patients were required to meet any of the following criteria: (1) radiographic criteria: pelvic incidence (PI) – lumbar lordosis (LL) $\geq 25^\circ$, thoracic 1 pelvic angle $\geq 30^\circ$, sagittal vertical axis ≥ 15 cm, thoracic scoliosis $\geq 70^\circ$, thoracolumbar/lumbar scoliosis $\geq 50^\circ$, or global coronal alignment ≥ 7 cm; (2) procedural criteria: posterior spinal fusion ≥ 12 levels, three-column osteotomy (3-CO), or anterior-column reconstruction (ACR); or (3) geriatric criteria: age older than or equal to 65 years and minimum 7 levels of spinal instrumentation during surgery. Exclusion criteria included active spinal infection or neoplasm, deformity due to acute trauma, neuromuscular conditions, syndromic scoliosis, inflammatory arthritis/autoimmune diseases, prisoners, and pregnancy or immediate plans to become pregnant.

Standard case report forms were completed. Standard demographic and upright radiographic measurements were recorded. DNA-methylation PhenoAge (PhenoAge) was calculated according to the method of Levine *et al.*⁵ when appropriate laboratory data were collected. Comorbidities were collected, the Charlson Comorbidity Index calculated and patients with two or more chronic conditions were categorized as “Multimorbid.” The Edmonton Frail Scale was collected and those patients scoring ≥ 8 points were considered frail.¹¹ Patient-reported outcomes measurements collected included the Oswestry Disability Index (ODI), the Scoliosis Research Society-22r, and the Patient-Reported Outcome Measurements Information System-Pain Interference, Physical Function, Depression, Anxiety, Ability to Participate in Social Roles and Activities, and Satisfaction with Participation in Discretionary Social Activities were collected. For this study, disabled was defined as an ODI of ≥ 40 . The ODI is a disability index comprised of questions related to low back pain and function. The threshold of 40 was chosen as this was found to be the point at which patients tended to prefer operative care in the Adult Symptomatic Lumbar Scoliosis trial.^{12,13}

Categorization of Disease States

Patients were categorized per the previously defined thresholds for disability, multimorbidity, and frailty. A one-way ANOVA compared means of continuous variables across categories with a Bonferroni correction for multiple comparisons. χ^2 tests compared counts of ordinal/nominal variables. Linear regression examined the relationship between the categories of frail, disabled, multimorbid, and none with chronological age. The coefficient of determination (r^2) measured the strength of association. Scatterplots depicted the distributions of each classification, as these syndromes are often classified as “yes” or “no” and not as a continuum. If strict classifications exist, one would expect cluster densities, rather than a spread of values.

Exploratory Factor Analysis

Exploratory factor analysis (EFA) examined potential overlap among measures of frailty, disability, comorbidity, and frailty. This measures whether these domains represent distinct latent constructs or a shared health-related concept, indicating possible conflation or “tangling.” Patients with complete data reflecting disability (individual responses to ODI), multimorbidity (CCI questionnaire), and frailty (components of EFS) were included. A principal axis factoring extraction method was selected with an oblique rotation applied to allow for correlation between factors. The total variance explained by each individual factor was considered a measure of distinction between disease categories.

Relationship With Physical Function

To assess the strength of relationships between frailty, disability, and multimorbidity we plotted regression lines and calculated coefficients of determination against the timed 3 m walk (objective), strongest handgrip dynamometer measurement (objective), and PROMIS-Physical Function (subjective).

Measure of Physiological Decline

A systems biology approach to systemic decline in function suggests that a continuous measure is preferred

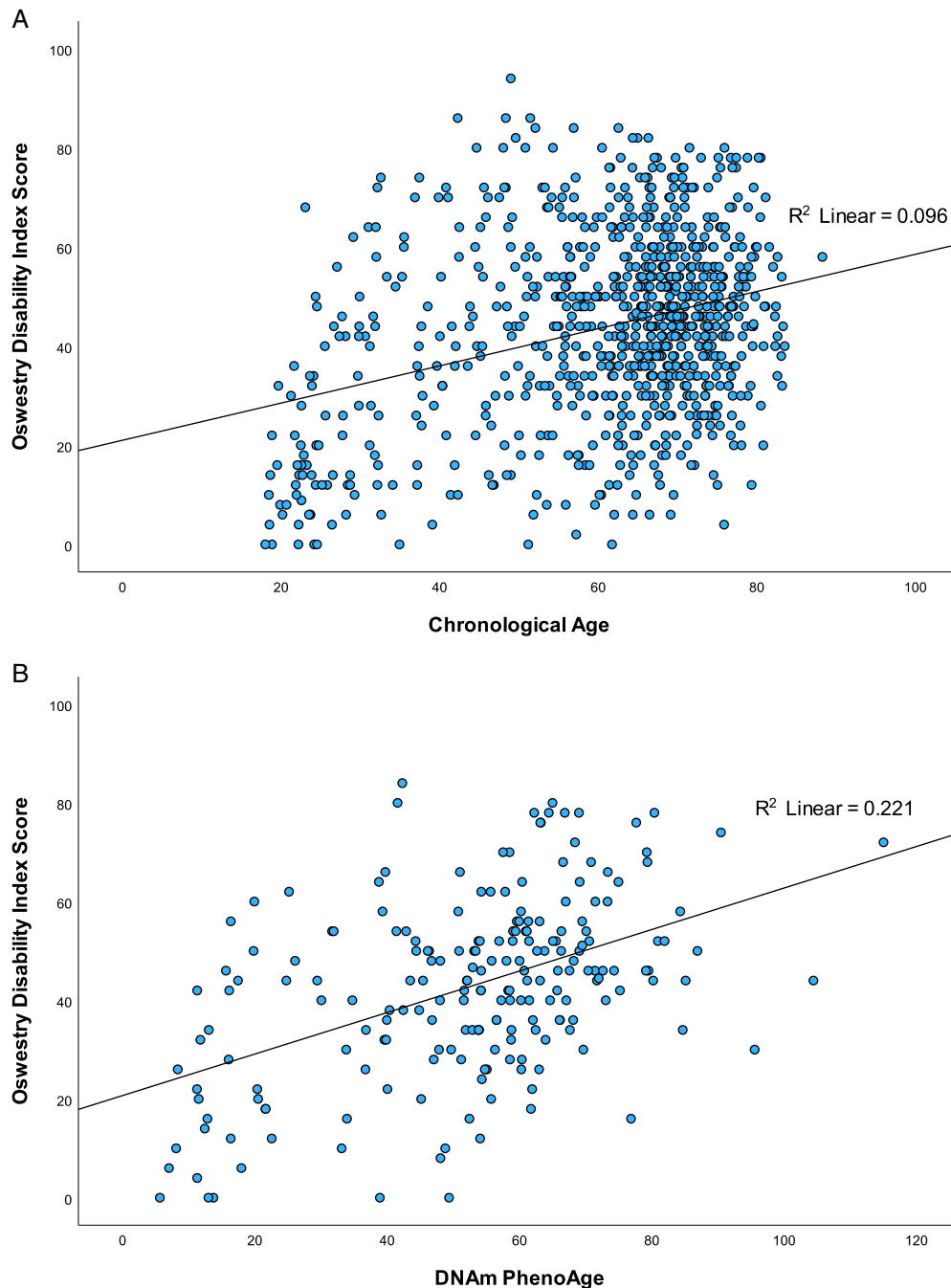


Figure 2. (A) Linear regression of disability (ODI) by chronological age. (B) Linear regression of disability (ODI) by DNAm PhenoAge. The coefficient of determination (r^2) measures the strength of association.

to categories of accumulated disease states or health deficits.¹⁴ PhenoAge is one such continuous measure of biological age.⁵ It is an epigenetic biomarker measuring physiological age and is related to morbidity, mortality, and increasing disability. Linear regressions were plotted for frailty, disability, and multimorbidity by PhenoAge where the coefficients of determination measured the strength of the relationship.

All statistics were performed using SPSS

(v29.0.2.0). Bonferroni corrections were applied to comparisons across the categories. As this is a retrospective, exploratory study no a priori sample size calculation was performed. Similarly, data for PhenoAge calculation was not available for many patients as this was not standardized in the registry. Imputation of PhenoAge is not feasible and rather than lose all data, we elected to drop those patients without these data for comparisons to biological age.

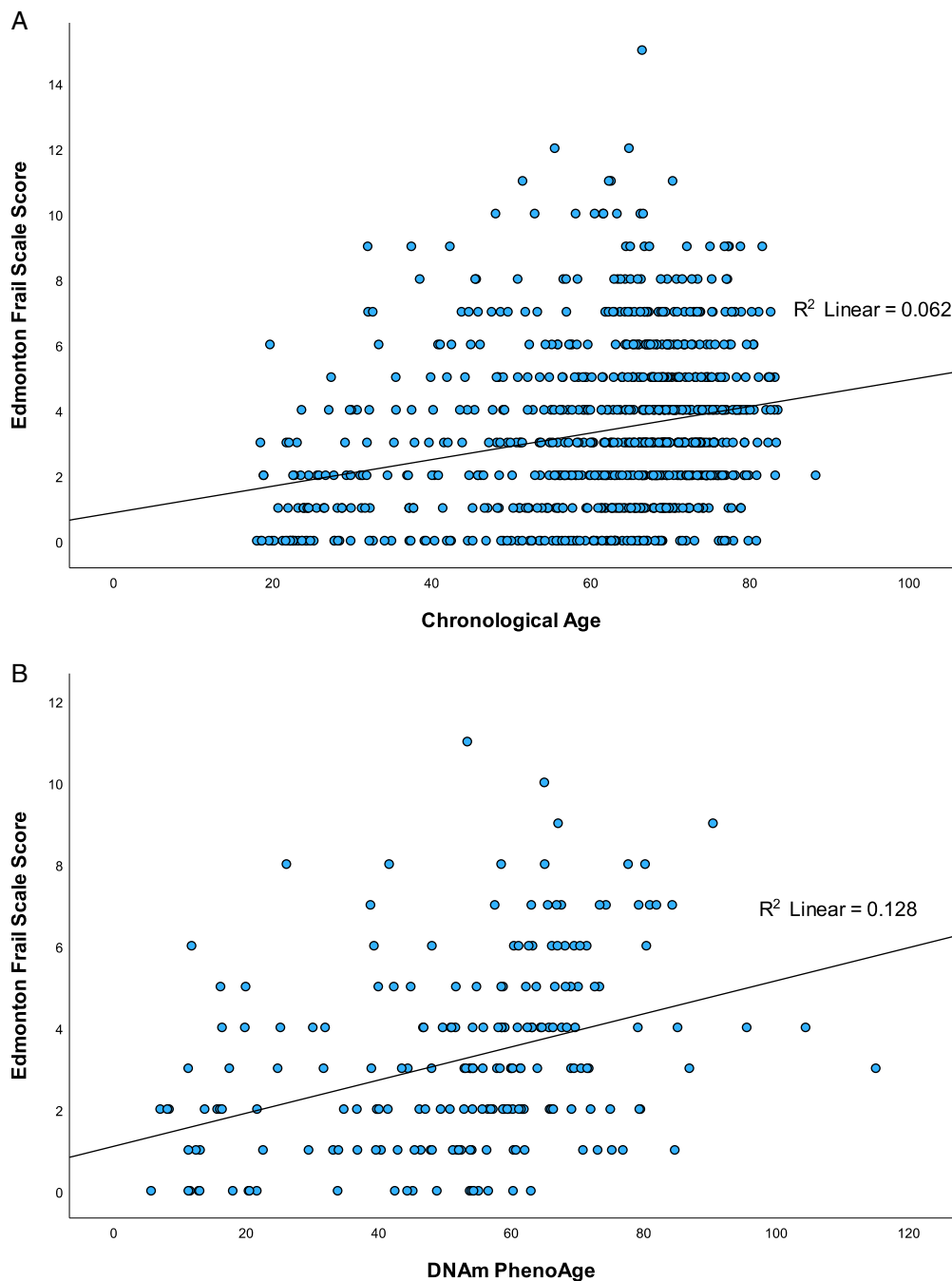


Figure 3. (A) Linear regression of frailty (EFS) by chronological age. (B) Linear regression of frailty (EFS) by DNAm PhenoAge. The coefficient of determination (r^2) measures the strength of association.

RESULTS

There were 1173 patients enrolled in the study and 861 (73%) contributed data for analysis. Of these 861 patients, 208 (18%) contributed laboratory data for DNAm PhenoAge calculation. Most of the cohort were female (584, 68%), white (758, 91%), with a median age of 66.0 years (interquartile range: 55.1–71.6).

Patients with disability only were the most prevalent

category (335, 38.5%), followed by patients without any categorization (None, 256, 29.7%). There were 53 patients meeting Frailty criteria, though none were Frail alone (Figure 1). Patients without disability, multimorbidity, or frailty were significantly younger by both chronological age and biological age ($P < .001$, Table 1). Patients exhibiting all three traits had significantly higher BMI ($P < .001$) and sagittal plane deformity ($P < 0.001$).

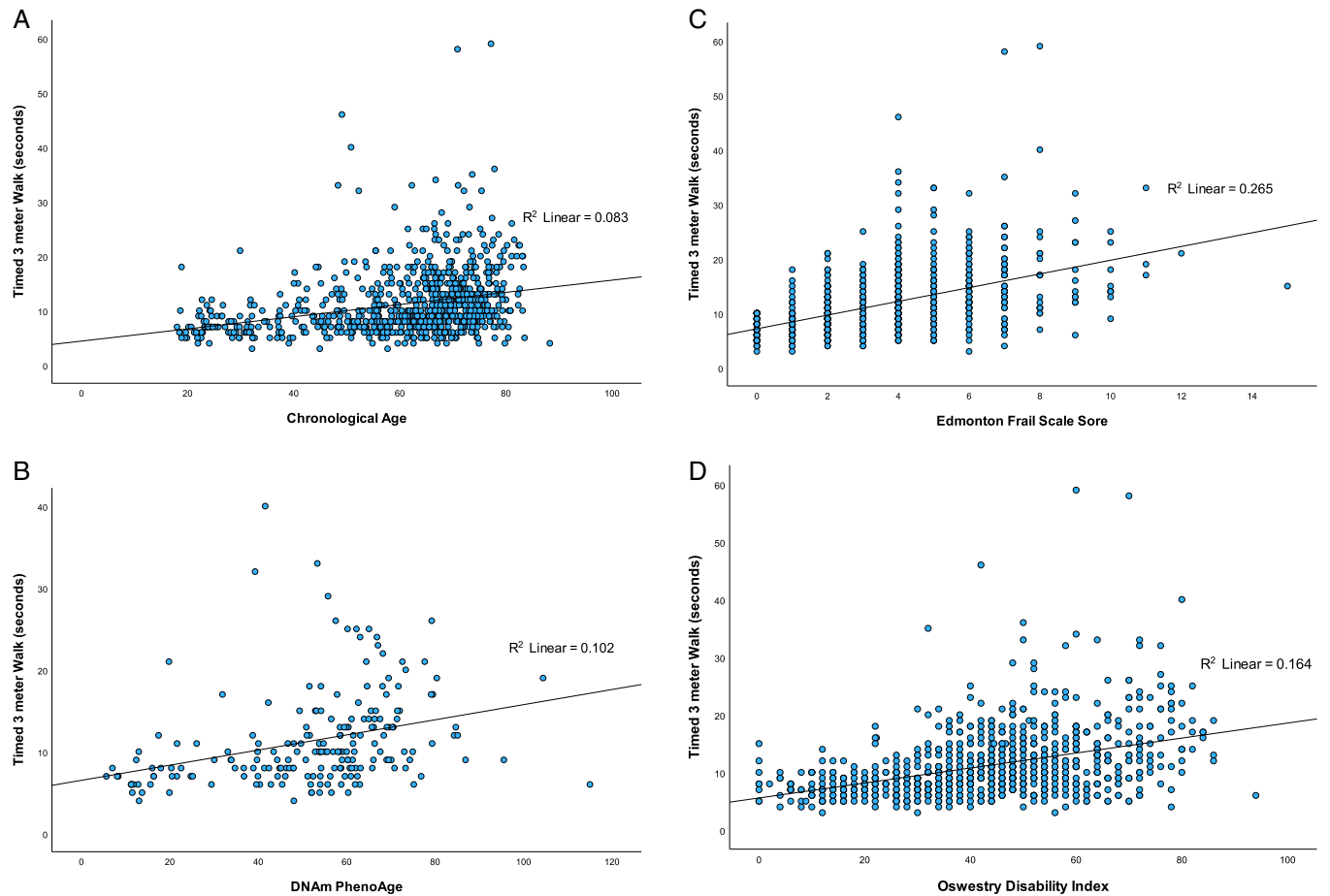


Figure 4. (A) Linear regression of the timed 3 m walk (objective measure of physical function) by chronological age. (B) Linear regression of the timed 3 m walk (objective measure of physical function) by DNAm PhenoAge. (C) Linear regression of the timed 3 m walk (objective measure of physical function) by frailty (EFS). (D) Linear regression of the timed 3 m walk (objective measure of physical function) by disability (ODI). The coefficient of determination (r^2) measures the strength of association.

Exploratory Factor Analysis

No patients in the cohort suffered from dementia and this CCI factor was dropped from the analysis. EFA showed a dominant single factor characterized by high loadings from both ODI disability items and functional components of the Edmonton Frail Scale (*e.g.* walking, independence, time to walk, Table 2). This suggests substantial overlap between self-reported disability and performance-based frailty indicators. Multimorbidity measures loaded weakly, supporting their relative independence.

Disability by Age

There was a negligible association between ODI and chronological age ($r^2=0.10$, Figure 2A). PhenoAge showed a stronger, positive association ($r^2=0.22$, Figure 2B) suggesting a weak relationship between increasing biological age and worsening disability. Neither scatter plot suggests categories of disability (*e.g.* no clusters of values suggesting “mild”, “severe”, etc) instead suggesting a continuum with a spread of values over the x axis.

Frailty by Age

There was a negligible positive association between increasing chronological age and the Edmonton Frail Scale ($r^2 = 0.06$, Figure 3A). Again, PhenoAge showed a stronger, positive association ($r^2 = 0.13$, Figure 3B) suggesting increasing frailty with increasing physiological decline as measured by DNAm. Neither scatter plot suggests categories of frailty (*e.g.* “at risk/prefrail”, “mild frailty”, etc) instead suggesting a continuum of pathology.

Physical Function Measures by Age, EFS, ODI, CCI

To examine the relationship between functional measures associated with disability and frailty, linear regressions for the 3 m timed walk, grip strength, and PROMIS-Physical Function were performed. Chronological age showed negligible associations with the objective measures: 3 m walk ($r^2 = 0.08$, Figure 4A), grip strength ($r^2 = 0.06$, Figure 5A). The association with PROMIS-PF was stronger ($r^2 = 0.16$, Figure 6A). PhenoAge showed similarly small associations with all: 3 m

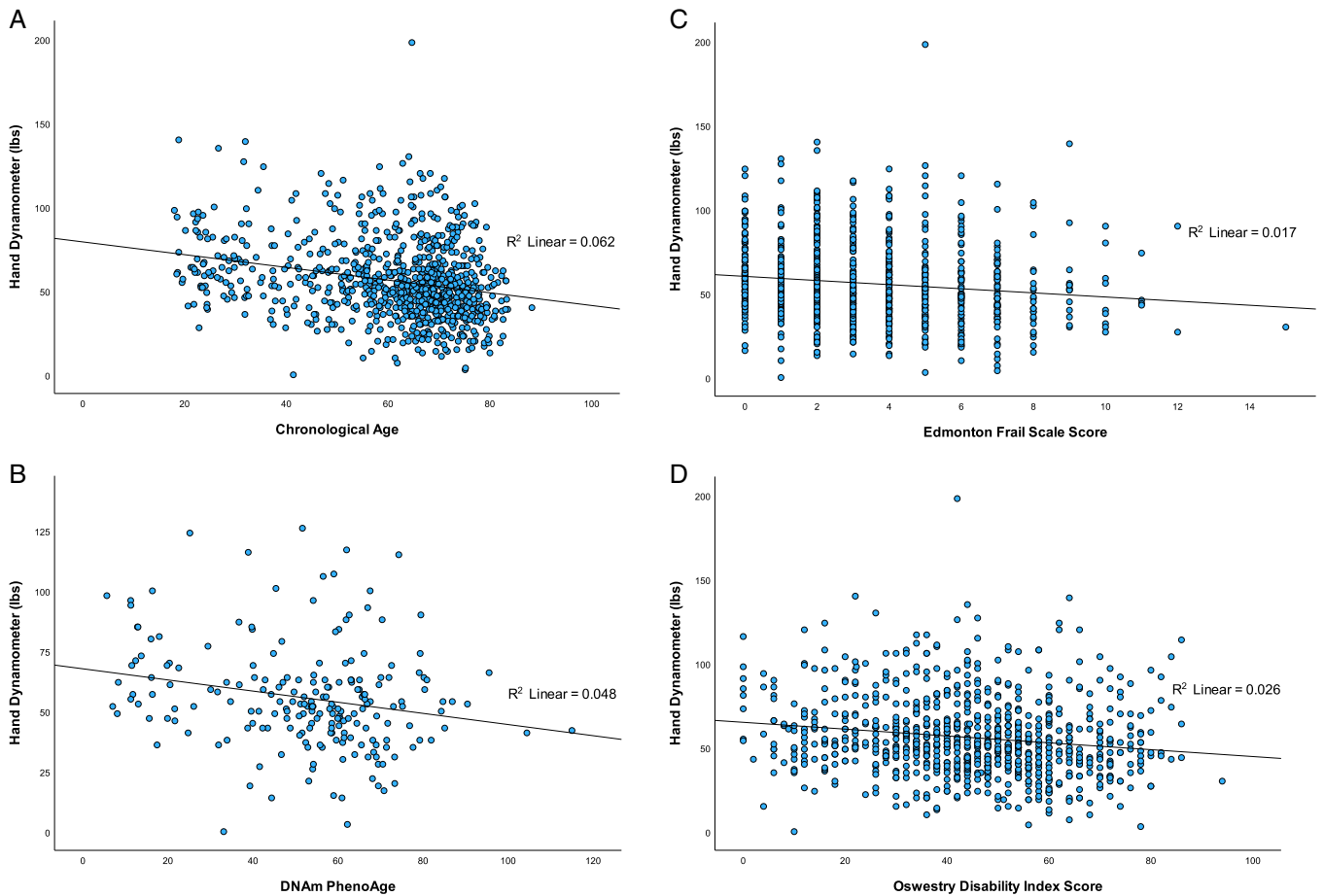


Figure 5. (A) Linear regression of the maximum handgrip strength dynamometer (pounds (lbs), an objective measure of physical function) by chronological age. (B) Linear regression of the maximum handgrip strength dynamometer (pounds (lbs), an objective measure of physical function) by DNAm PhenoAge. (C) Linear regression of the maximum handgrip strength dynamometer [pounds (lbs), an objective measure of physical function] by frailty (EFS). (D) Linear regression of the maximum handgrip strength dynamometer (pounds (lbs), an objective measure of physical function) by disability (ODI). The coefficient of determination (r^2) measures the strength of association.

walk ($r^2 = 0.1$, Figure 4B), grip strength ($r^2 = 0.05$, Figure 5B) PROMIS-PF ($r^2 = 0.25$, Figure 6B). The EFS had a moderate association with 3 m walk ($r^2 = 0.27$, Figure 4C), no association grip strength ($r^2 = 0.02$, Figure 5C) and a moderate association with PROMIS-PF ($r^2 = 0.26$, Figure 6C). The ODI had a weak association with the 3 m walk ($r^2 = 0.16$, Figure 4D), no association with grip strength ($r^2 = 0.03$, Figure 5D) and a strong association with PROMIS-PF ($r^2 = 0.6$, Figure 6D).

DISCUSSION

Frailty, although a popular subject of research, was rare in this cohort of almost 900 ASD patients, affecting only 6% of the population. This has implications for both clinical care and research surrounding ASD. Many ASD patients appear frail, with slow walking speed, difficulty with daily tasks, and an appearance of debilitation. This may lead to the conflation of disability and multimorbidity with frailty, a concept visited by gerontology

several decades ago.¹⁰ Moving forward, counseling patients requires the differentiation of these conditions. The patient who is disabled from a severe deformity, or a failed long-segment spinal fusion, stands much to gain from an appropriately performed spinal reconstruction. In contrast, the multimorbid patient requires preoperative optimization and lifestyle changes to improve their disability and candidacy for spine surgery. Finally, the patient who is truly frail (a rare occurrence in this multicenter data set of operative spinal deformities) may not be able to recover from the physiologic burden of a spine surgery, regardless of their comorbidity burden. If we are to appropriately counsel patients, we must be able to distinguish these three sources of perioperative morbidity, all of which can present as clinically similar scenarios.

We found moderate associations between walking time and the EFS and ODI scores. These suggest that slowed walking is a trait seen both in frailty (EFS) and disability (ODI). This hypothesis is supported by the ex-

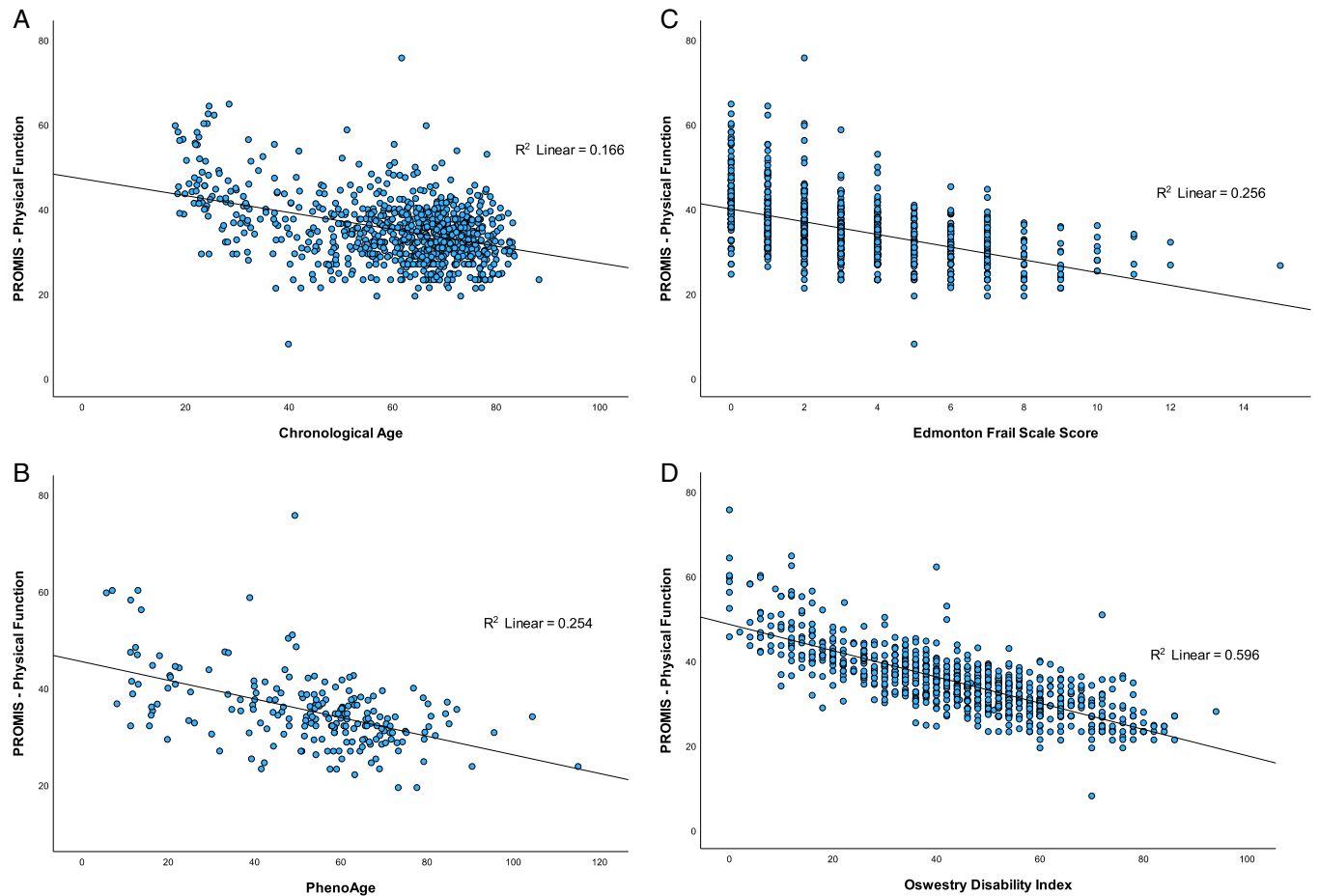


Figure 6. (A) Linear regression of the Patient-Reported Outcomes Measurement System-Physical Function (PROMIS-PF, subjective measure of physical function) by chronological age. (B) Linear regression of the Patient-Reported Outcomes Measurement System-Physical Function (PROMIS-PF, subjective measure of physical function) by DNAm PhenoAge. (C) Linear regression of the Patient-Reported Outcomes Measurement System-Physical Function (PROMIS-PF, subjective measure of physical function) by frailty (EFS). (D) Linear regression of the Patient-Reported Outcomes Measurement System-Physical Function (PROMIS-PF, subjective measure of physical function) by disability (ODI). The coefficient of determination (r^2) measures the strength of association.

ploratory factor analysis, which suggests overlap between subjective disability, frailty, and objective measures of physical function. The relationships between disability, multimorbidity, and frailty with chronological age and PhenoAge also support the contention that a measure of physiological decline is continuous. Spine surgery research often categorizes degrees of disability and frailty, creating categories that do not exist in nature. If unique categories existed, then we would observe clusters of patients, rather than a distribution of scores (Figures 2–6). The categorization of these continuous measures loses power, raising the risk of type 1 error (false discovery) and leading to erroneous conclusions. As frailty is an accumulation of time- and health-related physiological decline, then a continuous measure of this decline may be the optimal biomarker. PhenoAge is imperfect biomarker, as seen here with low to moderate associations with disability, multimorbidity, and frailty. This is because there are a number of biological processes that occur from the level of DNA-

methylation to expression of a phenotype (*e.g.* transcription, translation, protein expression). At each step, there will be natural variation and randomness. As such, the “ideal” biomarker will likely exist closer to the phenotype, rather than the genome.

Fried developed the concept of a frailty phenotype to describe the population of older patients at risk for adverse events due to an age-related decline in physiological reserves.¹⁵ The importance of a distinction between the three diseases examined here was emphasized, because each condition can lead to the development or worsening of another.¹⁰ Each is generally treatable where improvements in frailty and disability are possible and better control of chronic conditions is optimal. Finally, each is considered preventable but accurate prevention requires different interventions. This underscores the importance of avoiding categorization of these composite conditions and, instead, seeing them on a continuum where early recognition is required.

Assessment of frailty and identification of frailty may be challenging in the clinical setting. The EFS takes approximately five minutes to complete, though scoring and interpretation will add to this.¹⁶ Simple, quick assessments will aid surgeons with decision-making and counseling. Grip strength is regarded as a screen for frailty, with thresholds for “frail” proposed.¹⁷ We found no relationships between grip strength and measures of frailty and biological age, suggesting this may not be an appropriate screening test in ASD patients. The timed 3 m walk showed a much stronger relationship and this may be a more appropriate screening tool for clinic, albeit more labor intensive to obtain. Patient effort may affect any of these measures and patients should be encouraged to give maximum effort to best inform decisions.

This study is not without limitations and should be viewed as exploratory. It is not possible to make strong conclusions regarding frailty in this cohort because it was rare. This is of particular note as 27% of the enrolled cohort lacked sufficient data for inclusion. Selection bias may result in exclusion of patients that would affect our analyses, particularly if the most frail were omitted. In general, the prevalence of frailty in this cohort is consistent with other fields, though one may expect a lower prevalence in this elective surgery population when compared with non-elective surgeries and hospitalization.^{18,19} As our underlying hypothesis was that disability and frailty are often conflated, this low prevalence is confirmatory but does not negate the importance of recognizing, treating, and preventing frailty in this patient population. Our choice of an EFS score of ≥ 8 may be seen as too strict. If we were to choose ≥ 7 , then the prevalence of frailty would double to 12%, but would remain uncommon. That this debate may exist further emphasizes the need for a continuous measure as an a priori threshold leads to a premature decision, loss of power, and misclassification.²⁰ One may argue that the ODI is a poor choice to determine disability and may also argue against the threshold of 40 points, as we argue against such categorization within this paper. We feel comfortable using this value as it is approximately the value at which patients enrolled in the ASLS trial chose to cross from nonoperative care to operative treatment. With respect to both previous limitations, we have analyzed disability, multimorbidity, and frailty without thresholds in our analyses. Finally, we do not investigate the negative outcomes associated with these conditions. Given the overall paucity of frail patients and low number of discrete complication categories we cannot make strong conclusions in either way regarding the impact of these conditions on perioperative adverse events. We intentionally avoid the use of the composite “Adverse Event” and its sub-categories as the use of composite outcomes is rarely externally valid and repeatable and may propagate the research issues we discuss above.²¹

In summary, frailty was rare in this cohort of ASD patients and disability, multimorbidity, and frailty are distinct composited conditions with some overlap in

symptoms. In ASD patients, the clinical presentation may be similar. Furthermore, ASD may cause and exacerbate disability and frailty, blurring the ability to distinguish these composite conditions. It is important to understand that these conditions exist on a continuum, where distinct categories do not exist and early identification may prevent worsening and optimize outcomes, both related and unrelated to ASD.

➤ Key Points

- ❑ Frailty was uncommon, affecting 6% of the population, in this series of 861 surgical adult spinal deformity patients.
- ❑ Frailty, as measured by the Edmonton Frail Scale, and disability, as measured by the Oswestry Disability Index, share commonalities with objective measures of physical function, which complicates distinguishing these conditions.
- ❑ Handgrip strength was poorly associated with Edmonton Frail Scale score.
- ❑ Distinct categories of disability and frailty do not exist and continuous measures should be used when possible.

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