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Health Characteristics, Neuromuscular Attributes and Mobility among Primary Care Patients with Symptomatic Lumbar Spinal Stenosis: A Secondary Analysis

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Presentation

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Conflicts of Interest

Dr. Suri reports personal fees from Spaulding Rehabilitation Hospital, during the conduct of the study.

Abstract

Background and Purpose—Mobility problems are common among older adults. Symptomatic Lumbar Spinal Stenosis (SLSS) is a major contributor to mobility limitations among older primary care patients. In comparison to older primary care patients with mobility problems but without SLSS, it is unclear how mobility problems differ in older primary care patients with SLSS. The purpose of this study was to compare health characteristics, neuromuscular attributes, and mobility status in a sample of older primary care patients with and without SLSS who were at risk for mobility decline. We hypothesized that patients with SLSS will manifest poorer health and greater severity of neuromuscular impairments and mobility limitations.

Methods—This is a secondary analysis of the Boston Rehabilitative Study of the Elderly (Boston RISE). Fifty community-dwelling primary care patients age ≥ 65 years at risk for mobility decline met inclusion criteria. SLSS was determined based on CT scan and self-reported symptoms characteristic of neurogenic claudication. Outcome measures included: health characteristics, neuromuscular attributes (trunk endurance, limb strength, limb speed, limb strength asymmetry, ankle range of motion {ROM}, knee ROM, kyphosis, sensory loss), and mobility (Late-life Function and Disability Instrument: basic and advanced lower extremity function sub-scales, 400-meter walk test, habitual gait speed, and Short Physical Performance Battery Score). Health characteristics were collected at a baseline assessment. Neuromuscular attributes and mobility status were measured at the annual visit closest to conducting the CT scan.

Results and Discussion—Five participants met criteria for having SLSS. Differences are reported in medians and interquartile ranges. Participants with SLSS reported more global pain, a greater number of comorbid conditions (SLSS: 7.0 +/− 2.0 vs No SLSS: 4.0 +/− 2.0, $p<0.001$), and experienced greater limitation in knee ROM (SLSS: 115.0 degrees, +/− 8.0, No SLSS: 126.0 degrees, +/− 10.0, $p=0.04$) and advanced lower extremity function compared to those without SLSS.

A limitation of this study was its small sample size and therefore, inability to detect potential differences across additional measures of neuromuscular attributes and mobility. Despite the limitation, the differences in mobility for participants with SLSS may support physical therapists in designing interventions for older adults with SLSS. Participants with SLSS manifested greater mobility limitations that exceeded meaningful thresholds across all performance-based and self-reported measures. Additionally, our study identified that differences in mobility extended beyond just walking capacity, but across a variety of tasks that make up mobility for those with and without SLSS.

Conclusions—Among older primary care patients who are at risk for mobility decline, patients with SLSS had greater pain, higher levels of comorbidity, greater limitation in knee ROM and greater limitations in mobility that surpassed meaningful thresholds. These findings can be useful when prioritizing interventions that target mobility for patients with SLSS.

Keywords

symptomatic lumbar spinal stenosis; lumbar spinal stenosis; neuromuscular attributes; mobility

INTRODUCTION

Symptomatic lumbar spinal stenosis (SLSS) is a common cause of mobility limitations among older adults.[1–4] Difficulty walking, climbing stairs and rising from a chair are examples of mobility limitations, which are experienced by as many as 25% of adults 70 years and older.[5–7] Performance of these mobility tasks commonly worsens with aging, but more so for older adults with SLSS.[8–10] SLSS is defined as the presence of radiographic lumbar spinal stenosis (LSS) and characteristic self-reported symptoms. Radiographic LSS is a progressive and degenerative spine disorder causing anatomical narrowing of the central spinal canal, neuroforaminae and, or lateral recess.[1–4] The hallmark symptom of SLSS is the presence of neurogenic claudication, defined as pain, numbness and/or weakness in either lower extremity that worsens with walking and lessens with spinal flexion postures.[9] The presence of neurogenic claudication is a major contributor to limitations in mobility.[2, 4] In addition, older adults with SLSS may manifest multiple comorbidities, more so than those without SLSS, that contribute further to greater limitations in mobility.[11]

Substantive research exists on the operative management of SLSS, which has modest outcomes regarding mobility performance.[12–15] However, there is no agreement on which interventions or combination of interventions is optimal for the non-surgical management of SLSS.[3, 13] While the non-surgical evidence base is weak, there is a general agreement that treatment should involve rehabilitative exercise.[3, 13] A fundamental principle in developing rehabilitative exercises for patients with SLSS is that the underlying neuromuscular impairments that limit mobility should be corrected or mitigated in order to improve mobility skills and optimize the individual's participation in life roles.[16] The link between reduction in impairments and improvements in activities and participation is well conceptualized within the *International Classification of Functioning, Disability and Health*.[16, 17] However, at this point in time, the neuromuscular impairments that are characteristic of SLSS have not been well-described especially in comparison to older adults with mobility problems from other causes. As a result there is a lack of available evidence to guide the development of efficacious treatment plans for patients with SLSS.[3, 13]

While impairment-based treatments are being developed for older adults with mobility problems in general there is little or no information on whether these same treatment paradigms should also be applied to patients with SLSS.[18] Furthermore, much of the existing research addressing mobility limitations has focused mostly on walking and does not address the broader range of activities that encompass mobility skills.[1, 19–21] In order to address these knowledge gaps a secondary analysis of the Boston Rehabilitative Impairment Study of the Elderly (Boston RISE) was conducted. The aims of this study were to compare (1) health characteristics, (2) neuromuscular attributes and (3) mobility status among older primary care patients with and without SLSS who are at risk for mobility decline. It was hypothesized that older primary care patients with SLSS would manifest poorer health and greater severity of neuromuscular impairments and mobility limitations.

METHODS

This study is a secondary analysis of data from Boston RISE. Boston RISE is a longitudinal cohort study of 430 older primary care patients who are at risk for mobility decline, as defined by self-reported difficulty or the inability to walk one half mile or climb one flight of stairs without assistance. It includes measures of 11 neuromuscular attributes as well as self-reported and performance based measures of mobility across a large range of functional tasks including walking capacity.[22] Patients were recruited from primary care practices with the following inclusion criteria: age ≥ 65 years and an ability to communicate and understand English. Patients excluded were those with terminal illness, major surgery or myocardial infarction in the past 6 months, a planned major surgery, a planned move from the Boston area within 2 years, major medical problems that would interfere with safe and successful testing, a Mini-Mental State Examination (MMSE) score of less than 18, and a Short Physical Performance Battery (SPPB) score of < 4.[22] Boston RISE also contains questions that have been identified as components of the clinical definition of SLSS.[9] All study procedures for Boston RISE were approved by the appropriate Institutional Review Board. The rights of human subjects were protected and informed consent was received for all participants.

SLSS has been defined as the presence of radiographic LSS as evidenced on cross-sectional imaging and characteristic self-reported lower extremity symptoms, such as neurogenic claudication.[7] For inclusion in this secondary analysis, participants must have undergone a computerized tomography (CT) scan of the lumbar spine and completed the questionnaire with components of the clinical definition of SLSS, i.e., neurogenic claudication. The presence of neurogenic claudication was ascertained according to participant self-report of pain, numbness and/or weakness in either lower extremity (LE) that increases with walking and decreases with bending forward or sitting down, or resolves upon sitting.[9, 23] Although imaging was not part of the primary aims of Boston RISE a separate ancillary study of Boston RISE was conducted by different authors among 51 participants and included CT scans of the lumbar spine that were used for this study.[24] Additional criteria for the current study included completion of measures of neuromuscular attributes and self-reported and performance-based mobility. On the basis of these criteria, of the 430 participants from the Boston RISE 50 participants met the inclusion criteria.

Boston RISE conducted assessments over 2 years of follow up. The CT scan study containing radiographic evidence of LSS was conducted at different stages of follow-up for the 50 participants in this secondary analysis. Assessment data from the annual visit closest to the referent CT scan was used. If measures of neuromuscular attributes or mobility were missing for that visit then the most recent available measures were used for analysis. Forty-three out of 50 participants had complete data available at the time the CT scan was conducted. Seven participants did not have complete data with regard to certain physiologic and performance-based measures at the time of the CT scan because tests were not performed for safety reasons or participants refused. Data from the most recent follow-up assessment was analyzed for these participants.

CT scans evaluated the lumbar spine levels from: L2 through S1. All scans were read by a spine physiatrist[a] trained in the assessment of lumbar spine CT scans for research purposes. The reader was blinded to clinical information including the results of the SLSS questions. Grading of central canal and neuroforaminal stenosis was conducted using established grading systems that have been well described previously.[23, 25, 26] The presence of radiographic LSS was evaluated and graded at the central canal, and the right and left neural foraminae using a categorical classification system. Central canal stenosis was graded according to the degree of narrowing for the cross-sectional area of the central canal. Narrowing of less than or equal to 1/3 of the normal cross-sectional area was classified as mild stenosis; between 1/3 and 2/3 narrowing as moderate stenosis; and greater than 2/3 narrowing as severe stenosis.[25] Neuroforaminal stenosis was assessed using sagittal CT reformations and graded qualitatively based on the area of the foramina and the degree of deformity of the epidural (perineural) fat, surrounding the nerve root.[26] A normal neural foramen was defined by the classic oval or inverted pear shape appearance.[26] Mild neuroforaminal stenosis included slight narrowing of the foramina due to bony stenosis or intervertebral disc changes and/or mild effacement of the perineural fat, but with fat still completely surrounding the nerve root. Moderate neuroforaminal stenosis included deformity of the perineural fat with perineural fat only partially surrounding the nerve root. Severe foraminal stenosis included circumferential obliteration of the perineural fat. Lateral recess stenosis was not examined as part of this study due to the lack of consensus on optimal grading systems and poor reliability in prior studies.[27]

Participants with self-reported neurogenic claudication symptoms and the presence of moderate to severe central canal stenosis or severe neuroforaminal stenosis, evidenced by CT scan, were classified as having SLSS.[9] Participants with self-reported neurogenic claudication symptoms, but without moderate to severe central canal stenosis or severe neuroforaminal stenosis were classified as not having SLSS. Participants without self-reported neurogenic claudication symptoms regardless of radiographic findings were classified as not having SLSS.

Selected health characteristics from Boston RISE were used for this study including: age, gender, comorbidities, body mass index (BMI), cognitive status, and global pain. The number of comorbidities was ascertained from a validated self-reported questionnaire developed by Sangha and colleagues.[28] It includes questions about the presence of a broad range of chronic conditions.[28] BMI was calculated as weight(kg)/height^2(m^2).[29] Cognitive status was measured using the MMSE.[30] Global pain was evaluated using the Brief Pain Inventory (BPI) Pain Severity Subscale with the final score (0–10) comprising an average of 4 self-reported pain ratings: pain at its worst in the last week, at its least in the last week, on average, and at its current status.[31]

Eight neuromuscular attributes from the Boston RISE assessment were evaluated (trunk extensor endurance, limb strength, limb speed, limb strength asymmetry, ankle ROM, knee

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ROM, kyphosis, and sensory loss). Trunk extensor endurance was measured using a specialized plinth that stabilized the participant's pelvis and lower extremities in a position 45 degrees from a horizontal plane. Trunk extensor endurance was recorded as the time in seconds that a participant could maintain a neutral trunk position with arms crossed over his/her chest (0–150 seconds).[7] Limb strength and limb speed were measured using a pneumatic leg press. Limb measures represent the composite lower extremity including the hip, knee, ankle and foot. The 1 repetition maximum (RM) was conducted for both lower extremities. The higher value of either lower extremity was recorded as the 1RM and normalized based on body weight (Newtons/kilogram). Limb speed was measured in meters/second and derived from the participant's maximum limb power measure.[32] Limb speed corresponds to the speed of movement of the lower extremity as measured on the pneumatic leg press. Limb strength asymmetry was measured as the ratio of the higher value of a participant’s right or left side divided by the lower value of the opposing side. Lower extremity range of motion was measured using a goniometer and based on standardized protocols.[33] Impaired ankle range of motion (yes/no) was recorded as the inability to dorsiflex greater than or equal to 90 degrees, or the inability to plantarflex greater than 20 degrees on either lower extremity. Maximum knee flexion ROM was recorded with the participant positioned in supine and measured in degrees.

Additionally, kyphosis was measured using a flexicurve ruler placed over the participant's thoracic spine. The curvature of the ruler was then traced onto a paper and a measure of height/length x 100 was recorded for the amount of thoracic kyphosis.[34] Sensory loss (yes/no) was measured using the Semmes-Weinstein monofilament test and assessed over the dorsum of the right and left great toes proximal to the nail bed. Sensory loss was recorded if a participant was unable to feel less than 3 out of 5 touches for both, the 5.07 and 4.17 monofilaments on one or both toes.[35] Three neuromuscular attributes were not used for this pilot study. Knee flexion and extension ROM asymmetry and knee extension ROM were excluded from analysis due to a high level of covariance among these variables. Maximum knee flexion ROM was used to represent the attribute for knee ROM.

Mobility was evaluated using both self-reported and performance-based measures conducted at the closest annual visit to the CT scan. These measures were selected in order to represent assessment of a broad spectrum of tasks that make up mobility, beyond just walking. Self-reported mobility was measured using the Late-life Function and Disability Instrument.[36] Within this instrument functional mobility tasks are categorized into 3 domains: upper extremity function, basic lower extremity (BLE) function and advanced lower extremity (ALE) function. Our analysis included the BLE and ALE domains, which best correspond to lower extremity mobility tasks. Each domain is calibrated on a 0–100 scale with higher scores indicating better functional mobility.

Performance-based mobility limitations were measured using the following tools: the SPPB[37]; habitual gait speed (HGS)[38]; and the 400-meter walk test[39]. The SPPB is comprised of 3 tests: standing balance, usual paced walking speed, and a 5-repitition chair stand. Each of the 3 tests is scored from 0–4 with the total score being a sum of the 3 tests (0–12), and a higher score indicating better performance. HGS, measured in meters per second, was derived from the usual walking speed subcomponent of the SPPB, which

measures the time it takes to walk 4 meters. The 400-meter walk test is measured in minutes as the time it takes to walk 400 meters as quickly as possible, up to a maximum of 15 minutes. All measures are reliable and valid measures among older adults.[5, 37, 38, 40–43]

Descriptive statistics were obtained for both the SLSS and no SLSS groups using medians and interquartile ranges for continuous variables and frequencies with percentages for categorical variables. For the comparison of health characteristics (Aim 1), Wilcoxon rank sum tests for continuous data were employed. Non-parametric statistics were used due to the non-normal distribution of the data and the inequality of the number of subjects within groups. Chi-square was used to compare categorical data. The same approach was utilized for comparison of neuromuscular attributes (Aim 2) as well as mobility measures (Aim 3). An alpha level of 0.05 was used to determine statistical significance. SAS 9.3[b] was used for statistical analyses.

RESULTS

Of the 50 participants, 5(10%) met criteria for manifesting SLSS. Significant differences in health characteristics were observed for median number of chronic illnesses (SLSS: 7.0 +/− 2.0 vs No SLSS: 4.0 +/− 2.0, $p<0.001$) and median global pain (SLSS: 3.0 +/− 2.5 vs No SLSS: 1.75 +/− 2.25, $p=0.008$) for participants with and without SLSS (Table 1).

Median knee ROM limitation was significantly greater among participants with SLSS as compared to those without SLSS (SLSS: 115.0 degrees, +/− 8.0, No SLSS: 126.0 degrees, +/− 10.0, $p=0.04$) (Table 2). No other statistically significant differences were observed among neuromuscular attributes between those with and without SLSS.

Participants with SLSS had significantly lower, median self-reported scores on the ALE subscale of the Late-life Function and Disability Instrument when compared to participants without SLSS (SLSS: 33.12 +/− 2.83 vs No SLSS 45.81 +/− 16.35, $p=0.03$). There were no significant differences in BLE function or in performance-based mobility measures between participants with and without SLSS (Table 3).

DISCUSSION

The major findings of this pilot study illustrate that older primary care patients who are at risk for mobility decline with SLSS manifest important differences in health characteristics, knee ROM and mobility when compared to a similar sample without SLSS.

The 5 older primary care patients with SLSS experienced a higher level of pain and more comorbidities compared to those without SLSS. In spite of the small number of subjects with SLSS, these findings are consistent with previous studies conducted on older adults with SLSS. Battie and colleagues reported greater comorbid conditions for a community-based sample of 245 adults with SLSS who were ≥ 65 years.[11] In that study, those with SLSS had a greater number of comorbidities (mean of 3.1) compared to those without (mean of 1.4). While our measure of comorbidities was different, we also saw a similar magnitude

[b]SAS Institute Inc., 100 SAS Campus Drive, Cary, NC, 27513-2414.

of difference, which was almost 2-fold greater for those with SLSS as compared to those without (7.0 vs. 4.0 conditions).

Participants with SLSS reported greater median global pain than those without SLSS. Although the difference in median global pain was relatively small (1.25 points on a 10 point scale), pain severity as measured by the Brief Pain Inventory is predictive of incident decline in mobility skills and disability among community-dwelling older adults.[44] This finding can be useful when prioritizing interventions that target mobility for patients with SLSS.

Older primary care patients with SLSS demonstrated significantly greater limitations in ALE function. While the difference between groups on the other mobility outcome measures did not reach statistical significance, all of the observed differences were in the direction of greater mobility limitation for the SLSS group and the differences were of a magnitude that could be clinically relevant. Specifically, minimal clinically important differences (MCIDs) for the 400-meter walk, HGS and the SPPB have been reported (Table 4).[45–47] The differences in performance of the 400-meter walk, HGS and the SPPB among participants with SLSS and without SLSS surpassed MCIDs. For the BLE and ALE function measures, statistically relevant magnitudes have also been defined. The minimal detectable change based on a 90% confidence interval (MDC_{90}) are reported to be 4.38 and 6.31 out of 100 for BLE function and ALE function, respectively.[48] Also, observed and clinically meaningful differences in mobility extended beyond just walking skills, which is the type of mobility limitation most classically associated with SLSS.[8] Thus, despite limitations in sample size, the findings of this study highlight that while all participants were at risk for mobility decline based on the study selection criteria, those with SLSS trended toward more clinically meaningful limitations within a wide range of mobility skills than those without SLSS.

It is important to note that participants with SLSS had a greater limitation in knee flexion ROM than participants without SLSS. A possible explanation for the greater limitation of knee flexion is a muscle length impairment of the quadriceps musculature based on the compensatory posture assumed by individuals with SLSS.[49, 50] Another explanation is that rates of knee osteoarthritis (OA) may have been higher among those with SLSS. Unfortunately, Boston RISE does not include adjudication of knee OA within its assessment methods so the influence of OA on the findings could not be evaluated.

Limitations of this pilot study included the small sample size and unequal distribution between, those with (n=5) and without (n=45) SLSS, leading to a lack of power to identify additional potential statistically significant differences (type II error) among measures of neuromuscular attributes and mobility. While we only observed statistically significant differences in knee range of motion, among the neuromuscular attributes, we did observe potentially important median differences in certain attributes in which statistically significant differences were not observed. For example, participants with SLSS scored 48% lower on the trunk extensor muscle endurance test. This finding is consistent with a previous study that demonstrated decreased trunk extensor muscle endurance among older primary care patients with low back pain.[51] This finding can be useful when selecting targeted interventions for patients with SLSS.

Another limitation of this study is that Boston RISE participants are not necessarily representative of all primary care patients since the inclusion criteria required older age (≥65 years) and being at risk for mobility decline. Although these criteria might be expected to lead to a high prevalence of SLSS in Boston RISE, only 10% of subjects in the current sample had SLSS. However, this prevalence is consistent with that reported in a recent population-based study of older Japanese adults, which found the prevalence of SLSS ranging from 10%-14% in men and women ≥ 60 years.[52] Finally, data assessments for this study were limited to a subset of participants who had CT scans performed as part of an ancillary study of Boston RISE. In addition to the CT Scan, participants completed a measure of trunk extensor strength. The sample of 50 represents those older primary care patients who were willing to participate in the trunk extensor strength measure and a CT Scan of the lumbar spine. The inclusion criteria of the CT scan study may not have appealed to all participants of Boston RISE due to symptomatology or safety concerns in performing the strength measure. Therefore, the participants used for this secondary analysis may not be fully representative of the entire Boston RISE cohort.

Despite these limitations, this study may contribute to our understanding of SLSS. The study compared several measures of neuromuscular attributes and mobility that are commonly evaluated by physical therapists and potentially amendable to rehabilitative care. The differences in mobility in the subjects with SLSS extended beyond just walking, the task most commonly associated with SLSS, and may inform physical therapists' approach to care for those with SLSS. Findings from this pilot study should be confirmed within a larger and more representative sample of patients with SLSS. However, this line of investigation helps to clarify the scope of mobility limitations among patients with SLSS and provides a basis for future studies that may identify the patterns of impairment and mobility limitations that may manifest in patients with SLSS and provide a foundation for developing intervention strategies that may reduce mobility limitations in this population.

CONCLUSION

Older primary care patients with SLSS experience greater pain, comorbidities, greater limitation in knee ROM and mobility when compared to those without SLSS. These findings may help guide future research on potential rehabilitative targets for improving mobility in older patients with SLSS.

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Table 1

Differences in Health Characteristics Among Participants with and without SLSS

Variable	SLSS (n=5)	No SLSS (n=45)	p value	95% Confidence Interval
Age (years)	81.0(2.0)	77.0(12.0)	0.77	(−5.00, 9.00)
Gender (% female)*	4(80%)	31(69%)	1.00	---
Comorbidities	7.0(2.0)	4.0(2.0)	<0.001	(1.00, 4.00)
BMI	30.4(7.2)	27.7(4.8)	0.15	(−1.50, 9.50)
MMSE (0–30)	26.0(2.0)	28.0(2.0)	0.17	(−4.00,1.00)
Brief Pain Inventory (0–10)	3.0(2.5)	1.8(2.3)	0.008	(0.50, 4.75)

Median (interquartile range) with Wilcoxon Exact p value, or frequency (percent)*, BMI=Body Mass Index, MMSE=Mini-mental State Examination

Table 2

Differences in Neuromuscular Attributes Among Participants with and without SLSS

Neuromuscular Attributes	SLSS (n=5)	No SLSS (n=45)	p value	95% Confidence Interval
Trunk Extensor Endurance(s)	72.7(68.7)	150.0(95.6)	0.19	(−82.49, 9.52)
Limb Strength (N/kg)	5.2(4.7)	6.6(2.5)	0.47	(−3.25, 2.25)
Limb Strength Asymmetry	1.1(0.2)	1.1(0.1)	0.90	(−0.11, 0.16)
Limb Speed (m/s)	0.8(0.4)	1.0(0.3)	0.21	(−0.51, 0.12)
Ankle ROM (% impaired)*	2(40%)	32(71%)	0.31	---
Knee ROM (deg)	115.0(8.0)	126.0(10.0)	0.04	(−23.00, −1.00)
Kyphosis	10.9(4.7)	9.9(3.3)	0.12	(−0.55, 6.89)
Sensory Loss (% impaired)*	1(20%)	12(27%)	1.00	---

Median (interquartile range) with Wilcoxon Exact p value, or frequency (percent)*, s=seconds, N/kg=Newtons per kilogram, m/s=meters per second, deg=degrees, kyphosis was measured using a flexicurve ruler as height/length x 100.

Table 3

Differences in Mobility Among Participants with and without SLSS

Mobility Measures	SLSS (n=5)	No SLSS (n=45)	p value	95% Confidence Interval
LLFDI-BLE Subscale (0–100)	53.4(14.7)	68.6(10.6)	0.08	(−20.96, 3.21)
LLFDI-ALE Subscale (0–100)	33.1(2.8)	45.8(16.4)	0.03	(−27.61, −1.47)
SPPB (0–12)	9.0(4.0)	12.0(2.0)	0.29	(−4.00, 0.00)
HGS (m/s)	0.7(0.3)	1.0(0.3)	0.21	(−0.40, 0.11)
400-meter walk (min) *	8.1(2.0)	5.8(2.0)	0.07	(−0.23, 3.78)

Median (interquartile range) with Wilcoxon Exact p value, LLFDI=Late-Life Function and Disability Instrument (with higher scores indicating better functional mobility), BLE=Basic Lower Extremity, ALE=Advanced Lower Extremity, SPPB=Short Physical Performance Battery (with higher scores indicating better performance), HGS=Habitual Gait Speed (with higher score indicating faster walking speed), m/s=meters per second, min=minutes.

*Age-related normative range for 400-meter walk, mean (standard error of mean): 4.5(0.3) to 7.5(0.1) minutes.[53]

Table 4

Differences in Mobility Among Participants with and without SLSS and Meaningful Change Scores

Mobility Measures	SLSS (n=5)	No SLSS (n=45)	p value	MDC90	MCID
LLFDI-BLE Subscale (0–100)	53.4(14.7)	68.6(10.6)	0.08 *	4.38[48]	n/a
LLFDI-ALE Subscale (0–100)	33.1(2.8)	45.8(16.4)	0.03 *	6.31[48]	n/a
SPPB (0–12)	9.0(4.0)	12.0(2.0)	0.29 *,t	1.66[48]	0.27–1.5[45,46]
HGS (m/s)	0.7(0.3)	1.0(0.3)	0.21 *, t	0.13[48]	0.05–0.2[45–47]
400-meter walk (min)	8.1(2.0)	5.8(2.0)	0.07 *, t	1.25[48]	0.33–0.5[46]

Median (interquartile range) with Wilcoxon Exact p value, MDC_{90}=Minimal Detectable Change (scores are based on a 90% confidence interval and derived from Boston RISE), MCID=Minimal Clinically Important Difference (values are based on previously published meaningful differences in samples of older adults. Ranges are from small meaningful change to substantially/moderate meaningful change), LLFDI=Late-Life Function and Disability Instrument (with higher scores indicating better functional mobility), BLE=Basic Lower Extremity, ALE=Advanced Lower Extremity, n/a=not available in the literature, SPPB=Short Physical Performance Battery (with higher scores indicating better performance), HGS=Habitual Gait Speed (with a higher score indicating faster walking speed), m/s=meters per second, min=minutes, difference in mobility measure:

* ≥ MDC_{90};

t ≥ MCID.