Predicting Physical Function from Standardized Physical Performance, PROMIS, and Activity Monitor Measures in Older Adults

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INTRODUCTION

Older adults' physical function is regularly assessed during physical therapy to guide clinical decision making and quantify progress. Physical function can be measured via standardized physical performance (SPP) tests (e.g., Timed Up & Go, gait speed, step tests), yet these task-based measures only moderately reflect how people perceive their physical function[1,2,3]. Symptoms and other contextual factors also shape self-perceived functional status[4,5]. To measure person-centered factors, patient reported outcome measures are utilized. The Patient Reported Outcomes Measurement Information System (PROMIS) is widely used to assess a range of symptoms and contextual factors across multiple health domains. As wearable activity monitors become more common, real-world activity (e.g., steps, sedentary time) alongside clinic tests may further improve assessment of physical function. There is confusion how SPP tests, self perceptions tracked using PRO's (PROMIS) and physical activity (AM) data correlates with physical function. Providers often consider these measures as indicating physical function, but which to prioritize in clinical practice is unclear.

The purpose of this analysis was to evaluate the independent and combined contributions of performance measures (SPP), self-perceptions (PROMIS Measures), and real-world physical activity data with older adults' perceptions of physical function. A clear understanding of how these seemingly concurrent measures correlate will assist clinicians in prioritizing outcomes that are more indicative of patients' perception of their physical function.

METHODS

Cross sectional data was collected on 88 older adults recruited with flyers and word of mouth from the local community. After screening, volunteers over 65 years old were assessed using SPP and PROMIS measures. The SPP measures included the Timed Up & and Go, 30-sec Sit to Stand (STS), 10 meter walk test (10MWT), and 2-minute Step Test (2MST). The PROMIS measures included PF, pain interference (PI), Depression, General Self Efficacy (SE) and Ability to Participate in Social Roles (APSR). Activity data was monitored via hip worn ActivePal® (PAL Technologies) (AM). AM was worn for 5-6 days after the initial testing. AM variables included average daily step count, upright time (non-sitting or lying), and activity score (MET·hours). Predictors for PROMIS-PF were grouped into SPP (TUG, STS, 10MWT, 2MST), PROMIS (APSR, Pain Interference, Depression, General Self-Efficacy), and AM (steps, upright time, MET·hours) sets. Multiple linear regressions (univariable and APSR+TUG) were estimated; results are presented as F (p), R^2, RMSE, b, SE, and β. A forward stepwise process was completed for multivariable models. A p value of < 0.05 was considered statistically significant, with the emphasis on effect size, R^2, and RMSE due to the exploratory nature. All calculations were completed with STATA 19.

References

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Figure 1.

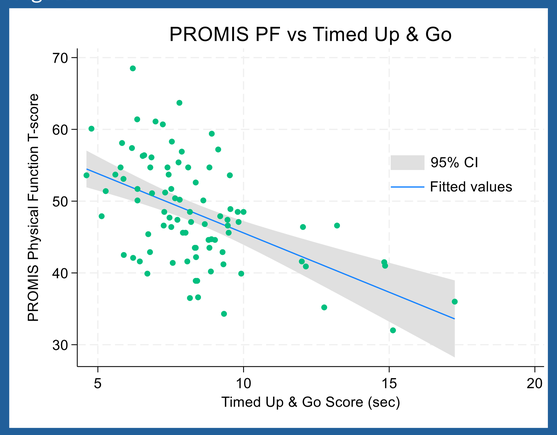

Figure 2.

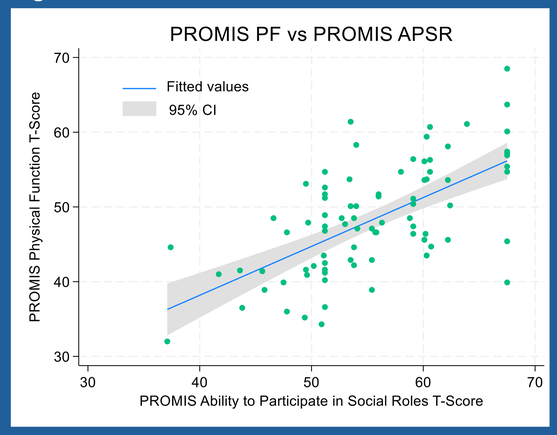

Table 2. Regression Summary Predicting PROMIS Physical Function

PROMIS Physical Function	F	p	R^2	RMSE	Coef.	SE	β
Timed Up and Go	31.83	<0.001	0.27	6.29	-1.65	0.3	-0.52
30-sec Sit to Stand	2.19	0.14	0.03	7.19	0.31	0.21	0.16
10-m Walk Test	0.04	0.85	0	7.36	-0.72	3.71	-0.02
Pain Interference	20.22	<0.001	0.19	6.62	-0.42	0.09	-0.44
Depression	3.12	0.08	0.03	7.23	-0.21	0.12	-0.19
Participation Social Roles	54.56	<0.001	0.39	5.76	0.65	0.09	0.62
Self Efficacy	12.2	<0.001	0.12	6.89	0.35	0.1	0.35
Multivariable Predictor: TUG + APRS	38.07	<0.001	0.47	5.38			
·APRS					0.52	0.09	0.49
·TUG					-1.01	0.27	-0.32

Table 1. Descriptive Statistics

	n (88)	Mean(STD), Median[a], Frequency %	Range
Age		75.4 (7.1)	65-95
Gender			
Male	28	32.60%	
Female	60	67.40%	
Height (meter)		1.68 (0.1)	1.52-1.93
Mass (Kg)		75.56 (20.09)	46.26-172.33
BMI (Kg/m^2)		26.52 (6.07)	18.06-59.50
Comorbidities		2[a]	0-6
Falls in last 12 months			
0	63	72%	
1	16	18%	
2	3	3%	
≥3	6	7%	
PROMIS Measures (T-Score)	88		
Physical Function	88	48.31 (7.31)	32-68.5
Pain Interference	88	48.64 (7.57)	38.7-66.9
Depression	88	47.63 (6.62)	34.2-69.5
Ability to Participate in Social-Roles	88	55.50 (6.97)	37.1-67.5
General Self Efficacy	88	49.53 (7.44)	33.5-69.2
Timed Up and Go (sec)	88	8.33 (2.29)	4.61-17.25
60-69y	22	7.05 (0.98)	5.60-9.91
70-79y	45	8.07 (2.47)	4.61-15.13
80-99y	21	9.30 (2.23)	6.36-17.25
30-sec Sit to Stand (#)	87	12.91 (3.8)	4.0-23.0
60-69y	22	12.77 (3.95)	9.0-23.0
70-79y	46	11.91 (4.02)	4.0-22.0
80-99y	19	12.83 (3.25)	6.0-18.0
10-meter Walk Test (m/s)	88	1.24 (0.23)	0.31-1.92
60-69y	22	1.22 (0.22)	0.90-1.92
70-79y	45	1.19 (0.26)	0.31-1.72
80-99y	21	1.24 (0.19)	0.81-1.50
2-min Step Test (#)	88	84.35 (26.74)	8-194
60-69y	22	89.75 (22.94)	58-139
70-79y	45	79.35 (28.15)	14-194
80-99y	21	68.61 (25.76)	8-121
ActivePal Monitor			
Avg. Daily Upright Time (min)	88	337.54 (108.26)	46.27-628.06
Avg. Daily Steps (#)	88	7093.96 (3258.36)	1282-16355
Avg. Activity Score (MET*Hours)	88	33.41 (1.35)	30.57-37.04

RESULTS

In single-predictor models, APSR showed the strongest association with PF (b=+0.654, β=+0.623, R^2=0.388, p<0.001), followed by Pain Interference (b=−0.421, β=−0.436, R^2=0.190, p<0.001) and General Self-Efficacy (b=+0.347, β=+0.353, R^2=0.124, p=0.001). Depression was not significant. Among SPP tests, TUG was strongly related to PF (b=−1.653 s, β=−0.520, R^2=0.270, p<0.001), whereas STS-30 and 10-m walk were not significant alone. The activity-monitor block (steps, upright time, MET·h) was collectively non-predictive (R^2=0.035, p=0.392), and each AM variable was nonsignificant on its own (R^2≈0.014–0.019). In a multivariable SPP model (10MWT, 2MST, TUG), fit improved (R^2=0.329, Adj 0.305), with TUG (β=−0.520, p<0.001) and 2MST (β=+0.263, p=0.007) contributing independently. A concise two-predictor model with APSR + TUG explained R^2=0.473 (Adj 0.460); both were independent predictors (APSR: b=+0.517, β=+0.493, p<0.001; TUG: b=−1.012, β=−0.318, p<0.001). Overall, participation (APSR) was the dominant correlate of perceived function, with mobility speed (TUG) adding unique information; activity-monitor metrics did not explain PF in this cohort.

CONCLUSION

In our sample of community-dwelling older adults perceived physical function (PROMIS-PF) was explained best by PROMIS domains, especially Ability to Participate in Social Roles (APSR), with Timed Up & Go (TUG) adding independent mobility information; together these two measures accounted for ~46–47% of PF variance, whereas activity-monitor metrics (steps, upright time, MET·h) did not meaningfully contribute. Findings suggest that when the goal is to understand patients perceived function, clinicians can should utilize multiple PROMISE domains in combination with SPP's. Especially in older adults who may not value performance-based aspects of physical function as highly as their ability to participate in social roles.