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CT-based lower-limb muscle-specific strength as a clinically relevant marker of sarcopenia

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Introduction

- Sarcopenia is an age-related muscle disease characterized by reduced muscle mass and strength, leading to disability, falls, and mortality.
- Recent consensus statements highlight muscle-specific strength (MSS) as a key construct reflecting muscle quality beyond mass alone.
- We quantified CT-based lower-limb MSS and explored its relationship with clinical outcomes in comparison with conventional muscle indices.

Methods

- 50 participants diagnosed with sarcopenia according to the Asian Working Group for Sarcopenia 2019 criteria were included.
- Skeletal muscle Index (Appendicular skeletal mass / height^2)(SMI) was obtained by Bioelectric impedance (BIA), muscle strength by handgrip, knee extensor and flexor strength, and CT-based volumes of the quadriceps and hamstrings were used to calculate lower limb MSS.
- Relationships between MSS and clinical outcomes were analyzed using correlation and linear regression.

Table 1. Correlation among the SMI, HGS, EXT, FLX, EXTMSS, FLXMSS

	SMI	HGS	EXT	FLX	EXTMSS	FLXMSS
SMI		0.58**	0.39**	0.486**	-0.271	-0.231
HGS			0.56**	0.587**	0.132	0.103
EXT				0.809**	0.681**	0.484**
FLX					0.408**	0.627**
EXTMSS						0.602**
FLXMSS						

**p<0.01

Results

- SMI showed low but significant correlations with lower-limb strength (EXT, r = 0.39; FLX, r = 0.486) but was not associated with MSS (Table 1).
- Knee extensor and flexor strength demonstrated moderate correlations with MSS (EXT–EXTMSS, r = 0.681; FLX–FLXMSS, r = 0.627), and the MSS of knee extensors and flexors were also moderately related (r = 0.602). (Table 1)
- Regarding clinical outcomes, Korean Falls Efficacy Scale (K-FES) showed significant negative correlations with lower limb strength and lower limb MSS (r = −0.523, −0.412). (Table 2)
- PHQ-9 demonstrated negligible to low correlations with SMI (r = 0.28) and FLXMSS (r = -0.325), and MoCA-K was also weakly correlated with FLX (r = 0.285) and FLXMSS (r = 0.44).
- In regression analyses, knee extensor strength and MSS remained significant predictors of KFES, while additional associations were observed between MSS and psychological as well as cognitive measures. (Table 3)

Conclusion

- CT-based lower-limb MSS was associated with fall-related self-efficacy, depressive symptoms, and cognitive function in older adults
- These findings suggest that incorporating muscle quality–based indices may provide additional clinical insight into sarcopenia-related vulnerability

Table 2. Correlation between the muscle parameters and outcomes.

	FTST	step length	step speed	step width	KADL	K-IADL	K-FES	number of f/d
SMI	-0.023	-0.053	-0.041	0.211	0.169	0.082	0.101	-0.177
HGS	0.076	0.072	-0.26	-0.102	-0.084	0.012	-0.238	-0.131
EXT	-0.016	0.127	0.027	0.019	-0.144	-0.037	-0.523**	-0.13
FLX	0.008	0.121	0.034	0.002	-0.089	-0.06	-0.421**	-0.18
EXTMSS	-0.008	0.114	0.085	-0.075	-0.153	-0.001	-0.412**	0.171
FLXMSS	-0.088	0.082	0.001	-0.07	-0.163	-0.007	-0.422**	-0.104

FTST: Five Times Sit to stand Test, K-ADL: Korean Activities of Daily living, K-IADL: Korean Instrumental Activities of Daily living
*p<0.05 **p<0.01

	SARQOL	EQ-5D-5L	PFS-physical	PFS-mental	PHQ-9	MOCA-K	SARC-F
SMI	-0.071	-0.17	0.152	0.316*	0.28*	-0.038	0.14
HGS	0.155	0.071	-0.069	-0.015	0.091	0.134	-0.223
EXT	0.363**	0.035	-0.123	0.056	0.016	0.272	-0.159
FLX	0.22	0.029	-0.004	0.143	-0.069	0.285*	-0.262
EXTMSS	0.242	0.056	-0.13	-0.1	-0.047	0.245	-0.015
FLXMSS	0.274	0.162	-0.157	-0.163	-0.325*	0.44**	-0.276

SARQOL: Sarcopenia Quality of Life Questionnaire, EQ-5D-5L: EuroQOL 5 Dimension 5 Level Questionnaire, PFS: Pittsburgh Fatigability Scale
*p<0.05 **p<0.01

Table 3. Simple linear regression between the muscle parameters and outcomes.
<K-FES>

	β	95% CI	p value
EXT	-0.172	-0.291 ~ -0.053	0.005
FLX	-0.173	-0.355 ~ 0.009	0.061
EXTMSS	-156.8	-267.694 ~ -45.906	0.007
FLXMSS	-104.307	-174.772 ~ -33.841	0.005

<PHQ-9>

	β	95% CI	p value
SMI	1.727	0.007 ~ 3.448	0.049
FLX MSS	-102.26	-188.614 ~ -15.907	0.021

<MOCA-K>

	β	95% CI	p value
FLX	0.175	0.004 ~ 0.346	0.045
FLXMSS	109.862	44.711 ~ 175.013	0.001

β: Regression coefficient, CI: Confidence interval