

# Association Between Lumbar and Hip Muscle Degeneration: A Cross-Sectional MRI-Based Analysis

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**INTRODUCTION:** Hip and spine disorders frequently coexist and contribute to impaired function and surgical outcomes. While paraspinal muscle quality is well studied, considerably less is known about hip musculature and its relationship to spinal degeneration. At present, no standardized vocabulary exists to describe hip muscle health. Developing such a framework is clinically important, as the periarticular muscle envelope may influence outcomes not only in hip arthroplasty, dysplasia, and degenerative joint disease, but also in spinal alignment and recovery after spine surgery. We hypothesized that hip muscle degeneration reflects region-specific and compensatory adaptations within hip-spine interactions, rather than a uniform systemic sarcopenic process. To test this, we investigated correlations between lumbar and hip muscle composition using MRI-based quantification, adapting validated paraspinal methods to the pelvic musculature.

**METHODS:** We retrospectively reviewed patients undergoing spinal fusion surgery (2017-2023) at a single tertiary orthopedic hospital. IRB approval was obtained. A total of 31 patients (female and male) with preoperative lumbar and pelvic MRI obtained within one year were included. Patients with prior fusion, total hip arthroplasty, or poor imaging quality were excluded. Muscle quality was assessed on lumbar T2-weighted and hip proton density (PD)-weighted axial MRI. Total cross-sectional area (CSA), functional CSA (fCSA), and fatty infiltration (FI) were measured for six hip muscles per side (gluteus minimus, medius, maximus, tensor fasciae latae, sartorius, rectus femoris) at the greater trochanter level. Lumbar muscles (psoas, multifidus, erector spinae) were analyzed at L4. Bilateral values were summed. Associations were tested with Spearman's correlations; multiple comparisons were adjusted using the Benjamini-Hochberg method.

**RESULTS SECTION:** Of 143 patients identified, 107 were excluded for prior spinal fusion and/or total hip arthroplasty and 5 for poor imaging quality, yielding 31 patients (71% female; mean age 63.5 ± 10.0 years; mean BMI 25.9 ± 4.6). Several moderate correlations were observed between lumbar and hip muscle composition. At the greater trochanter level (Table 1), erector spinae FI correlated inversely with sartorius FI ( $\rho = -0.508, p = 0.005$ ) and rectus femoris FI ( $\rho = -0.483, p = 0.008$ ). Multifidus FI was negatively associated with tensor fasciae latae FI ( $\rho = -0.396, p = 0.019$ ). Conversely, positive associations were observed between erector spinae and multifidus fCSA ( $\rho = 0.582, p = 0.032$ ) and gluteus minimus FI ( $\rho = 0.626, p < 0.05$ ). None of these associations remained statistically significant after correction for multiple comparisons.

## DISCUSSION:

Although no associations remained significant after adjustment, directional trends suggest interdependence between lumbar and hip musculature. Negative correlations between paraspinal and hip FI may reflect compensatory recruitment of hip muscles, while positive correlations between lumbar fCSA and hip FI suggest regional load redistribution. These findings indicate that hip muscle degeneration does not simply mirror global sarcopenia but instead follows region-specific, compensatory patterns, partially supporting our hypothesis. MRI-based methods validated for paraspinal muscles were successfully adapted to hip musculature, supporting the development of a standardized vocabulary for hip muscle quality and a new concept of Hip-Specific Sarcopenia.

Limitations include small sample size, cross-sectional design, and differing MRI protocols (lumbar T2 vs. hip PD). Findings should be considered exploratory and hypothesis-generating. Future efforts will focus on establishing normative reference values for hip muscle morphology and integrating alignment and gait parameters to further investigate the Hip-Specific Sarcopenia model. Ultimately, a deeper understanding of hip-spine muscle interactions may support more personalized treatment strategies in orthopedic and rehabilitation care, and this framework could be extended to the ankle-knee-hip-spine axis.

**SIGNIFICANCE/CLINICAL RELEVANCE:** Developing a reproducible vocabulary for hip muscle health is essential to characterize degeneration across the hip-spine axis and may directly impact spinal alignment and postoperative outcomes. It is also relevant for hip arthroplasty, dysplasia, and degenerative joint disease, with broad clinical importance as hip and spine pathologies frequently coexist in a significant number of patients.

**Table 1. Spearman correlation between paraspinal muscle parameters at L4 and hip muscle parameters at the level of the trochanter major.**

Abbreviations: functional CSA (fCSA), and fatty infiltration (FI). Significant correlations are shown in bold ( $p < 0.05$ ).

		Paraspinal muscles at L4												
		Erector spinae				Multifidus				Psoas				
		fCSA		FI		fCSA		FI		fCSA		FI		
		$\rho$	p-value	$\rho$	p-value	$\rho$	p-value	$\rho$	p-value	$\rho$	p-value	$\rho$	p-value	
Hip muscles at trochanter major	Gluteus minimus	fCSA	-0.204	0.483	0.327	0.253	-0.235	0.417	0.420	0.137	-0.095	0.750	-0.459	0.101
		FI	<b>0.582</b>	<b>0.032</b>	-0.424	0.132	<b>0.626</b>	<b>0.019</b>	-0.371	0.192	0.486	0.081	0.376	0.186
	Gluteus medius	fCSA	0.135	0.539	0.025	0.911	0.004	0.984	0.027	0.902	0.074	0.738	0.062	0.779
		FI	0.143	0.516	-0.210	0.337	0.254	0.243	-0.239	0.273	0.336	0.118	0.202	0.355
	Gluteus maximus	fCSA	0.027	0.889	-0.186	0.333	-0.119	0.539	0.230	0.230	-0.128	0.507	0.086	0.658
		FI	0.092	0.634	0.148	0.442	-0.008	0.967	-0.035	0.855	0.190	0.323	-0.043	0.823
	Rectus femoris	fCSA	0.004	0.984	0.139	0.474	-0.108	0.576	0.229	0.233	0.014	0.942	-0.150	0.438
		FI	0.192	0.319	<b>-0.483</b>	<b>0.008</b>	0.136	0.482	-0.360	0.055	-0.069	0.721	0.028	0.887
	Tensor fasciae latae	fCSA	-0.240	0.211	0.291	0.126	<b>-0.377</b>	<b>0.044</b>	<b>0.435</b>	<b>0.018</b>	-0.007	0.971	-0.012	0.951
		FI	0.165	0.393	<b>-0.373</b>	<b>0.046</b>	0.263	0.167	<b>-0.396</b>	<b>0.034</b>	-0.076	0.696	0.125	0.519
	Sartorius	fCSA	-0.116	0.564	<b>0.459</b>	<b>0.016</b>	0.120	0.550	0.158	0.432	0.157	0.434	0.129	0.521
		FI	0.004	0.982	<b>-0.508</b>	<b>0.005</b>	-0.056	0.774	-0.266	0.164	-0.263	0.167	-0.117	0.547