

Thenar Muscle Thickness Assessed by Point-of-Care Ultrasound and Geriatric Vulnerability in Hospitalized Older Adults: A Pilot Study

Nelson Anzoletti

Ospedale Civile dello Spirito Santo: Presidio Ospedaliero di Pescara

Michela Giansante

Pescara Hospital: Presidio Ospedaliero di Pescara

Claudia Paolini

Pescara Hospital: Presidio Ospedaliero di Pescara

Lucia Fasciani

Pescara Hospital: Presidio Ospedaliero di Pescara

Andrea Boccatonda

University of Bologna University Library of Bologna: Università degli Studi di Bologna Biblioteca
Universitaria di Bologna

Alessia Di Lorito

alessia.dilorito@gmail.com

Gabriele d'Annunzio University of Chieti and Pescara: Università degli Studi Gabriele d'Annunzio Chieti
Pescara <https://orcid.org/0009-0004-3324-0905>

Giulio Cocco

Gabriele d'Annunzio University of Chieti and Pescara: Università degli Studi Gabriele d'Annunzio Chieti
Pescara

Fabrizio Cedrone

Pescara Hospital: Presidio Ospedaliero di Pescara

Rosa Scurti

Pescara Hospital: Presidio Ospedaliero di Pescara

Cosima Schiavone

Gabriele d'Annunzio University of Chieti and Pescara: Università degli Studi Gabriele d'Annunzio Chieti
Pescara

Giovanni Iannetti

Pescara Hospital: Presidio Ospedaliero di Pescara

Keywords: older adults, geriatric assessment, malnutrition, muscle ultrasound, pressure injury, sarcopenia, falls, thenar eminence

Posted Date: October 19th, 2026

DOI: <https://doi.org/10.21203/rs.3.rs-11132923/v1>

License: © ⓘ This work is licensed under a Creative Commons Attribution 4.0 International License.
[Read Full License](#)

Abstract

Background

Malnutrition and sarcopenia frequently coexist in hospitalized older adults. Thenar muscle thickness (TMT) may provide a pragmatic correlate of geriatric vulnerability, but its clinical relevance is unestablished.

Methods

This retrospective, single-centre, cross-sectional pilot study analyzed 50 hospitalized patients aged 75 years or older, admitted between October and December 2024. Unadjusted Spearman correlations assessed associations between TMT and Mini Nutritional Assessment–Short Form (MNA-SF), Braden, and Conley scores. Bootstrap 95% confidence intervals were calculated for these three correlations.

Results

Mean age was 86.2 years; 60.0% of participants were women. Mean TMT was 2.62 cm (SD, 0.48). Overall, 84.0% of patients were malnourished or at risk of malnutrition, 66.0% had high pressure-injury risk, and 90.0% had a Conley score indicating fall risk. Higher TMT correlated with higher MNA-SF ($\rho = 0.760$; 95% CI, 0.595–0.859; $P < 0.001$) and Braden scores ($\rho = 0.560$; 95% CI, 0.340–0.729; $P < 0.001$), and with lower Conley scores ($\rho = -0.406$; 95% CI, -0.627 to -0.141 ; $P = 0.003$). Associations remained directionally consistent after adjustment for age and sex: partial ρ was 0.753 (95% CI, 0.572–0.865) for MNA-SF, 0.510 (95% CI, 0.251–0.709) for Braden, and -0.361 (95% CI, -0.602 to -0.054) for Conley. TMT was not significantly associated with length of stay ($\rho = -0.240$; $P = 0.093$).

Conclusions

In very old hospitalized adults, lower TMT was associated with poorer nutritional status and greater fall and pressure-injury risk. TMT may complement multidimensional geriatric assessment, but the small, unadjusted pilot design and absence of a sarcopenia reference standard preclude diagnostic or independent prognostic claims.

1. Introduction

Malnutrition and sarcopenia commonly coexist in hospitalized older adults and may compound vulnerability during acute illness. A systematic review and meta-analysis of hospitalized older populations found (risk of) malnutrition in 66% and sarcopenia in 37% of patients; the two conditions also showed substantial overlap (1). In a separate meta-analysis using the MNA, the pooled prevalence

of malnutrition in hospital settings was 22%, although estimates varied substantially among individual studies and settings (2).

Contemporary diagnostic frameworks recognize reduced muscle mass as a phenotypic component of malnutrition and recommend combining it with an etiologic criterion, such as reduced food intake or disease burden/inflammation, for diagnosis (3). Sarcopenia is clinically consequential in older adults: an observational geriatric inpatient cohort reported an independent association with 12-month mortality (4), while a community-based cohort linked EWGSOP2-defined sarcopenia with incident falls (5). These associations support early recognition of low muscle reserve but do not establish that muscle loss itself causes every adverse outcome.

Bedside ultrasound can quantify muscle size without ionizing radiation. A systematic review concluded that ultrasound is reliable and valid for muscle-size assessment in older adults, while also noting that small-muscle applications require further evaluation (6). A more recent meta-analysis found moderate-to-high diagnostic accuracy of ultrasound muscle-thickness measures for identifying sarcopenia in adults aged 65 years or older, but highlighted limitations in patient selection and reference standards and the need for standardized cutoffs (7).

The thenar eminence is a potentially practical peripheral site for point-of-care assessment. This study examined whether TMT, obtained on the non-dominant hand, was associated with nutritional status, fall risk, and pressure-injury risk in hospitalized older adults. The hypothesis was that lower TMT would be associated with poorer scores across these domains.

2. Materials and Methods

2.1. Study design and participants

This retrospective, single-centre, cross-sectional pilot study included consecutively admitted patients aged 75 years or older who were hospitalized in the Geriatric Unit of Santo Spirito Hospital, Pescara, Italy, between October and December 2024. The analysis evaluated the relationship between TMT and multidimensional markers of geriatric vulnerability assessed during hospitalization. The analytical cohort comprised 50 patients.

Patients were excluded if they had an acute neuromuscular disorder, severe hand deformity, or inability to undergo ultrasound assessment.

Study size: This was a retrospective convenience sample comprising all consecutively admitted eligible patients during October–December 2024; no formal a priori sample-size calculation was performed. The study was designed as an exploratory pilot investigation, and estimates should therefore be interpreted with attention to their confidence intervals.

2.2. Ultrasound assessment

TMT was measured at rest, in centimeters, on the non-dominant hand. A high-frequency linear transducer was placed longitudinally over the thenar eminence to visualize the abductor pollicis brevis muscle; thickness was measured using the local standardized acquisition procedure. Measurements were performed by trained nursing personnel.

Ultrasound examinations were performed using a high-frequency linear-array transducer (4–15 MHz) connected to a Esaote mylab sigma ultrasound system. Participants were examined in a seated position with the forearm resting comfortably on a flat surface and the hand in a neutral position. Measurements were obtained from the non-dominant hand.

The transducer was positioned longitudinally over the thenar eminence to visualize the abductor pollicis brevis muscle. Care was taken to minimize probe pressure and avoid compression of the underlying tissues. Muscle thickness was measured as the maximum distance between the superficial and deep muscle fasciae using electronic calipers. Three consecutive measurements were obtained and averaged for analysis.

2.3. Clinical assessment and outcomes

A multidimensional geriatric assessment was performed at admission. Nutritional status was assessed with the MNA-SF, a six-item screening instrument with a 0–14 total score (8). Scores were classified as malnourished (0–7), at risk of malnutrition (8–11), or normal nutritional status (12–14).

Pressure-injury risk was assessed using the Braden Scale, which was developed to support early identification of patients at risk of pressure injury (9). For this study's descriptive analyses, Braden scores were grouped as high risk (< 13), intermediate risk (13–14), or low risk (> 14). Fall risk was assessed using the Conley Scale, a fall-risk screening tool evaluated in older hospitalized medical patients (10). In this study, it was used as a clinical fall-risk score rather than as an observed-fall outcome. For this study's descriptive analyses, Conley scores of 0–1 were categorized as minimal risk and scores of 2–10 as fall risk.

Length of stay was calculated as the number of days from admission to discharge. In-hospital mortality was defined as death during the index hospitalization.

2.4. Statistical analysis

All analyses used the complete 50-patient dataset. Continuous variables are reported as mean $\pm$ SD, median, and range; categorical variables are reported as counts and percentages. Mean and median length of stay were both reported because the distribution was right-skewed. No data were missing for TMT, age, sex, MNA-SF, Braden score, Conley score, length of stay, or in-hospital mortality. Consequently, all analyses used complete data from all 50 participants; no imputation was performed.

Primary exploratory analyses evaluated unadjusted associations of TMT with MNA-SF, Braden, and Conley scores using Spearman rank correlations. Spearman correlations were also calculated for TMT with age and length of stay. Bootstrap percentile 95% confidence intervals for the three clinical-scale

correlations were obtained from 10,000 resamples. As sensitivity analyses, partial Spearman correlations between TMT and each clinical scale were adjusted for age and sex: TMT and outcome values were rank-transformed, each rank was residualized on age and sex, and the residuals were correlated. Bootstrap percentile 95% confidence intervals were obtained from 10,000 resamples. Tests were two-sided and used a significance threshold of $P < 0.05$. No multiplicity adjustment was applied. An exploratory Mann–Whitney U test compared TMT between women and men. Analyses were conducted using Python with the pandas and SciPy packages.

The manuscript follows STROBE reporting guidance for observational studies (11).

3. Results

3.1. Cohort characteristics

The cohort comprised 30 women (60.0%) and 20 men (40.0%). Mean age was 86.2 years (SD, 5.1; median, 86; range, 76–102); 12 patients (24.0%) died during hospitalization. Mean TMT was 2.62 cm (SD, 0.48; median, 2.60; range, 1.70–3.80). The mean MNA-SF score was 7.04 (SD, 3.42; median, 8; range, 1–12); 21 patients (42.0%) were malnourished, 21 (42.0%) were at risk of malnutrition, and 8 (16.0%) had normal nutritional status. The mean Braden score was 11.60 (SD, 2.38; median, 11; range, 6–16), with 33 patients (66.0%) classified as at high pressure-injury risk. The mean Conley score was 4.60 (SD, 2.45; median, 5; range, 0–10), with 45 patients (90.0%) scoring in the fall-risk range.

Length of stay was right-skewed, with a mean of 18.54 days (SD, 13.30), a median of 14.5 days, and a range of 3–54 days.

Table 1 shows demographic characteristics and clinical assessment measures of the geriatric patient cohort.

Table 1
Characteristics of the geriatric inpatient cohort (N = 50).

Characteristic	Value
Age, years	86.2 ± 5.1; median 86 (range 76–102)
Female sex, n (%)	30 (60.0)
Thenar muscle thickness (TMT), cm	2.62 ± 0.48; median 2.60 (range 1.70–3.80)
MNA-SF score	7.04 ± 3.42; median 8 (range 1–12)
Braden Scale score	11.6 ± 2.4; median 11 (range 6–16)
Conley Scale score	4.6 ± 2.4; median 5 (range 0–10)
Length of hospital stay, days	18.5 ± 13.3; median 14.5 (range 3–54)
In-hospital mortality, n (%)	12 (24.0)
<i>Data are mean ± standard deviation; median (range), unless otherwise indicated. Abbreviations: MNA-SF, Mini Nutritional Assessment–Short Form; TMT, thenar muscle thickness.</i>	

3.2. Associations between TMT and geriatric assessment measures

In unadjusted Spearman analyses, higher TMT was associated with higher MNA-SF and Braden scores and with lower Conley scores (Fig. 1). The association with MNA-SF was strong ($\rho = 0.760$; 95% CI, 0.595–0.859; $P < 0.001$); associations with Braden ($\rho = 0.560$; 95% CI, 0.340–0.729; $P < 0.001$) and Conley scores ($\rho = -0.406$; 95% CI, -0.627 to -0.141 ; $P = 0.003$) were moderate. In age- and sex-adjusted sensitivity analyses, the associations remained directionally consistent: partial Spearman ρ was 0.753 (95% CI, 0.572–0.865) for MNA-SF, 0.510 (95% CI, 0.251–0.709) for Braden, and -0.361 (95% CI, -0.602 to -0.054) for Conley. TMT was not significantly associated with length of stay ($\rho = -0.240$; $P = 0.093$) or age ($\rho = -0.275$; $P = 0.053$). Men had higher mean TMT than women (2.85 vs. 2.46 cm; $P = 0.008$).

4. Discussion

In this pilot cohort of very old hospitalized adults, greater TMT was strongly associated with better MNA-SF nutritional status and moderately associated with lower fall and pressure-injury risk. These findings position TMT as a candidate bedside correlate of multidimensional geriatric vulnerability, rather than as a stand-alone diagnostic test. The feasibility of point-of-care ultrasound for assessing muscle mass and strength in older adults supports further evaluation of this approach (12).

The association between TMT and MNA-SF aligns with evidence that malnutrition risk and sarcopenia often overlap in hospitalized older adults. However, MNA-SF and TMT are not interchangeable: MNA-SF is a nutritional screening measure, whereas TMT is a local anatomical measurement. The observed

cross-sectional associations cannot determine whether lower TMT reflects malnutrition, sarcopenia, acute disease burden, or their combined effects.

The Braden and Conley findings provide related but indirect clinical context. Higher TMT correlated with a higher Braden score and a lower Conley score, which denote lower pressure-injury and fall-risk classifications in this dataset. Previous cohort studies have linked established sarcopenia definitions with future falls and mortality (4, 5). They do not, however, validate thenar TMT as a predictor of falls, pressure injuries, or mortality.

TMT was not significantly associated with length of stay. Although the direction was toward shorter hospital stay with higher TMT, this 50-patient analysis was imprecise and length of stay was right-skewed. A larger prospective study should assess incremental prognostic value after adjustment for age, sex, nutritional status, comorbidity, functional status, and body size.

Muscle ultrasound is feasible for bedside muscle-size assessment in older adults, but small-muscle applications need additional validation and standardized cutoffs (6, 7). Within the literature retrieved for this manuscript, no direct validation of ultrasound-measured abductor pollicis brevis thickness in hospitalized older adults was identified. A relevant comparator study assessed point-of-care ultrasonographic vastus medialis thickness as a marker of muscle mass and strength in older adults (12). Thus, the present study offers preliminary construct-validity evidence for a novel measurement site; it does not establish diagnostic validity for sarcopenia.

The study has important limitations. Its retrospective, single-centre cross-sectional design and sample size limit precision and external validity. TMT was higher in men than in women, but the primary correlations were unadjusted; confounding by sex, age, body size, and illness severity cannot be excluded. The dataset contained no reference measure of muscle mass, strength, physical performance, or formal sarcopenia diagnosis. Finally, multiple exploratory correlations were assessed without multiplicity adjustment; P values should not be interpreted as confirmatory evidence for a prediction rule.

Future work should prespecify the ultrasound protocol, establish measurement reliability and sex-specific reference values, compare TMT with accepted muscle quantity, strength, and physical-performance measures, and evaluate prognostic performance in an adjusted prospective cohort.

5. Conclusions

Among very old hospitalized adults, lower TMT was associated with poorer nutritional status and higher fall and pressure-injury risk classifications. TMT may complement multidimensional geriatric assessment, but these data do not support its use as a diagnostic criterion for sarcopenia or as an independent prognostic marker. External prospective validation using a standardized thenar-ultrasound protocol and accepted sarcopenia reference measures is required before clinical implementation.

Declarations

Institutional Review Board Statement

The study was conducted in accordance with the Declaration of Helsinki.” Ethical approval was not required, as the study was based exclusively on routine clinical practice and non-invasive procedures.

Informed Consent Statement

“Written informed consent was obtained from all participants for study participation and publication of de-identified data.”

Data Availability Statement

“The de-identified data supporting the findings of this study are not publicly available because they contain sensitive clinical information. Data may be available from the corresponding author on reasonable request, subject to approval by the relevant ethics committee and applicable data-protection requirements.”

Author Contributions

“Conceptualization, [NA]; methodology, [NA, MG, CL]; software, [AB, GC, FC]; validation, [NA]; formal analysis, [GC, FC]; investigation, [NA, MG, CL]; resources, [initials]; data curation, [NA, MG, CL, LF]; writing—original draft preparation, [NA, ADL]; writing—review and editing, [NA, ADL]; visualization, [CS, GI]; supervision, [CS, GI]; project administration, [RS]. All authors have read and agreed to the published version of the manuscript.”

Funding

“This research received no specific grant from any funding agency in the public, commercial, or not-for-profit sectors.”

Conflicts of Interest

“The authors declare no conflicts of interest.”

References

1. Ligthart-Melis GC, Luiking YC, Kakourou A, Cederholm T, Maier AB, de van der Schueren MAE et al (2020) Frailty, sarcopenia, and malnutrition frequently (co-)occur in hospitalized older adults: a systematic review and meta-analysis. J Am Med Dir Assoc 21(9):1216–1224e12. 10.1016/j.jamda.2020.03.006
2. Cereda E, Pedrolli C, Klersy C, Lucidi C, Dall’Asta C, Scialfa MT et al (2016) Nutritional status in older persons according to healthcare setting: a systematic review and meta-analysis of prevalence data using MNA®. Clin Nutr 35(6):1282–1290

3. Cederholm T, Jensen GL, Correia MITD, Gonzalez MC, Fukushima R, Higashiguchi T et al (2019) GLIM criteria for the diagnosis of malnutrition: a consensus report from the global clinical nutrition community. *Clin Nutr* 38(1):1–9
4. Pérez-Zepeda MU, Sgaravatti A, Dent E (2017) Sarcopenia and post-hospital outcomes in older adults: a longitudinal study. *Arch Gerontol Geriatr* 69:105–109. 10.1016/j.archger.2016.10.013
5. Yang M, Liu Y, Zuo Y, Tang H (2019) Sarcopenia for predicting falls and hospitalization in community-dwelling older adults: EWGSOP versus EWGSOP2. *Sci Rep* 9:17636. 10.1038/s41598-019-53522-6
6. Nijholt W, Scafoglieri A, Jager-Wittenaar H, Hobbelen JSM, van der Schans CP (2017) The reliability and validity of ultrasound to quantify muscles in older adults: a systematic review. *J Cachexia Sarcopenia Muscle* 8(5):702–712
7. Yang F, Zhu L, Cao B, Zeng L, Yuan Z, Tian Y et al (2025) Accuracy of ultrasound measurements of muscle thickness in identifying older patients with sarcopenia and its impact on frailty: a systematic review and meta-analysis. *J Am Med Dir Assoc* 26(2):105419. 10.1016/j.jamda.2024.105419
8. Rubenstein LZ, Harker JO, Salva A, Guigoz Y, Vellas B (2001) Screening for undernutrition in geriatric practice: developing the short-form Mini-Nutritional Assessment (MNA-SF). *J Gerontol Biol Sci Med Sci* 56(6):M366–M372. 10.1093/gerona/56.6.M366
9. Bergstrom N, Braden BJ, Laguzza A, Holman V (1987) The Braden Scale for predicting pressure sore risk. *Nurs Res* 36(4):205–210
10. Palese A, Gonella S, Lant A et al (2016) Post-hoc validation of the Conley Scale in predicting the risk of falling with older in-hospital medical patients: findings from a multicentre longitudinal study. *J Clin Nurs* 25(21–22):3111–3119
11. von Elm E, Altman DG, Egger M, Pocock SJ, Gøtzsche PC, Vandenbroucke JP, STROBE Initiative (2007) The Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) statement: guidelines for reporting observational studies. *PLoS Med* 4(10):e296
12. Madden KM, Feldman B, Arishenkoff S, Meneilly GS (2021) A rapid point-of-care ultrasound marker for muscle mass and muscle strength in older adults. *Age Ageing* 50(2):505–510. 10.1093/ageing/afaa163

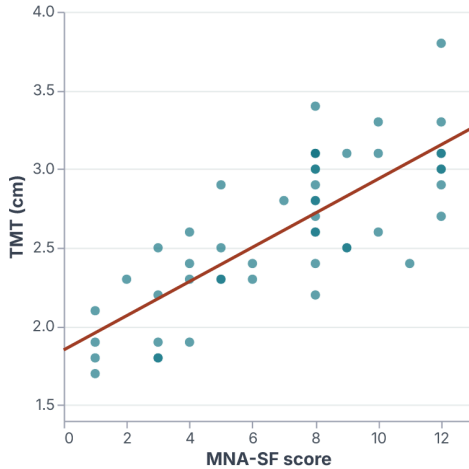
Figures

Thenar muscle thickness associations with clinical assessment scores

Geriatric inpatient cohort (N = 50); lines show fitted linear trends for visualization

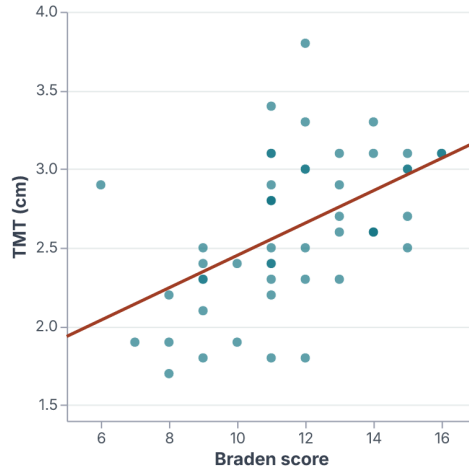
A. Nutritional status

Spearman rho = 0.76; 95% CI 0.595–0.859
p < 0.001



B. Pressure-injury risk

Spearman rho = 0.56; 95% CI 0.340–0.729
p < 0.001



C. Fall risk

Spearman rho = -0.41; 95% CI -0.627 to -0.141
p = 0.003

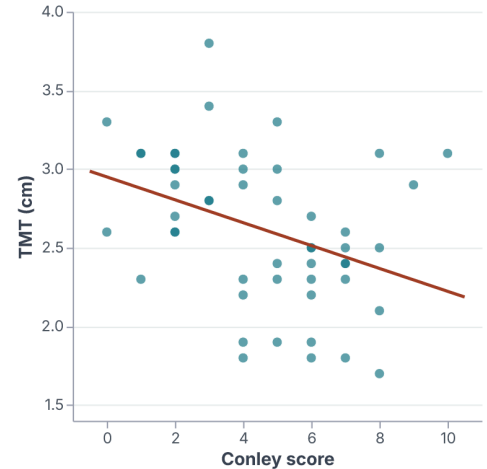


Figure 1

Associations between thenar muscle thickness (TMT) and clinical assessment scores in the geriatric inpatient cohort (N = 50). (A) TMT was positively associated with Mini Nutritional Assessment–Short Form (MNA-SF) score (Spearman rho = 0.760; 95% CI, 0.595–0.859; two-sided p < 0.001). (B) TMT was positively associated with Braden score (Spearman rho = 0.560; 95% CI, 0.340–0.729; two-sided p < 0.001). (C) TMT was inversely associated with Conley score (Spearman rho = -0.406; 95% CI, -0.627 to -0.141; two-sided p = 0.003). Each point represents one patient; solid lines show fitted linear trends for visualization only. Higher MNA-SF scores indicate better nutritional status, higher Braden scores indicate lower pressure-injury risk, and higher Conley scores indicate greater fall risk. TMT was measured in centimetres.