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Original Study

The Martin Vigorimeter Represents a Reliable and More Practical Tool Than the Jamar Dynamometer to Assess Handgrip Strength in the Geriatric Patient



Walther M.W.H. Sipers MD^{a,b,c}, Lex B. Verdijk PhD^b, Simone J.E. Sipers RN^a,
Jos M.G.A. Schols MD, PhD, Prof^c, Luc J.C. van Loon PhD, Prof^{b,*}

^a Department of Geriatric Medicine, Zuyderland Medical Center, Sittard-Geleen, The Netherlands

^b Department of Human Movement Sciences, NUTRIM School of Nutrition and Translational Research in Metabolism, Maastricht University, Maastricht, The Netherlands

^c Department of Health Services Research and Department of Family Medicine, CAPHRI, Maastricht University, Maastricht, The Netherlands

A B S T R A C T

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Background: Geriatric patients with low skeletal muscle mass and strength generally have a relatively poor clinical outcome following acute illness. Therefore, it is recommended to routinely assess skeletal muscle mass and strength in patients admitted to the acute care geriatric ward. Handgrip strength is generally measured as a proxy for muscle strength and/or functional performance.

Objective: To compare the applicability and test-retest reliability of measuring handgrip strength using the Jamar dynamometer and the Martin Vigorimeter in geriatric patients during hospitalization.

Design: A total of 96 geriatric patients (age 85 ± 5 y) admitted to the acute care geriatric ward participated in this study. Handgrip strength was assessed 3 times on 2 different occasions within 1 week of hospital admission using both the Jamar dynamometer and the Martin Vigorimeter.

Results: Maximal handgrip strength as determined over the 3 successive attempts performed on 2 occasions averaged 17 ± 7 kg and 35 ± 13 kPa when using the Jamar dynamometer and Martin Vigorimeter, respectively. Handgrip strength was significantly greater when using the dominant versus nondominant hand using both the Jamar dynamometer (17 ± 7 kg vs 16 ± 7 kg; $P = .003$) and Martin Vigorimeter (34 ± 12 kPa vs 33 ± 13 kPa; $P = .022$). Test-retest reliability showed an ICC of 0.94 and 0.92 when applying the Jamar dynamometer or Martin Vigorimeter, respectively (both $P < .001$). Furthermore, handgrip strength assessed with the Jamar and Martin Vigorimeter showed a strong correlation for both the first ($\rho = 0.83$, $P < .001$) and second measurement ($\rho = 0.79$, $P < .001$). Almost 80% of the geriatric patients needed help from nursing staff with transfer from bed to an arm-rested chair measuring handgrip strength with the Jamar dynamometer according to the Southampton protocol, which is not necessary when using the Martin Vigorimeter.

Conclusion: The Martin Vigorimeter represents a reliable and more practical tool than the Jamar dynamometer to assess handgrip strength in the geriatric patient on admission to the acute geriatric ward.

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Aging is associated with progressive loss of skeletal muscle mass and strength, commonly termed sarcopenia.^{1,2} This age-related decline in skeletal muscle mass and strength impairs functional performance, leading to a decreased level of independence and an increased risk of developing chronic metabolic diseases.³ In the

elderly patient, skeletal muscle mass and strength are strong prognostic factors for their functional decline, morbidity, and mortality.^{4–6} Low skeletal muscle mass and poor physical performance are highly prevalent in hospitalized geriatric patients.⁷ Geriatric patients with little skeletal muscle mass and strength generally have a poor clinical outcome following acute illness.^{8,9} Consequently, it is strongly recommended to routinely assess skeletal muscle mass and strength in patients admitted to the acute care geriatric ward.

Although there are various methods to assess skeletal muscle mass, strength, and functional capacity,¹⁰ most of these measurements are not practical or feasible to perform in the geriatric ward. Because

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* Address correspondence to Luc J.C. van Loon, PhD, Prof, Department of Human Movement Sciences, Maastricht University Centre, PO Box 616, 6200 MD Maastricht, The Netherlands.

E-mail address: L.vanLoon@maastrichtuniversity.nl (L.J.C. van Loon).

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of the simplicity of the measurement, it is generally recommended to assess handgrip strength as a proxy for muscle strength and/or functional performance. Handgrip strength is usually assessed using the Jamar dynamometer (Figure 1), which was introduced by Bechtol.¹¹ Mathiowetz et al¹² demonstrated that standardized positions and instructions of use are important to allow a reliable measurement of handgrip strength when using the Jamar dynamometer. However, measuring handgrip strength with the Jamar dynamometer according to standardized protocol¹³ is often complicated or simply impossible in geriatric patients admitted to the geriatric ward. In many cases, the predetermined sitting position in an arm-rested chair is impossible when patients are bedridden due to physical impairments. Furthermore, many geriatric patients frequently have painful arthritic hands, which makes handling of the 1.5 kg Jamar dynamometer challenging.

Another instrument to measure handgrip strength is the Martin Vigorimeter (Figure 1).¹⁴ The Martin Vigorimeter is a pseudodynamic dynamometer that measures the pressure when subjects press a rubber bulb connected by a tube to a manometer, with pressure being expressed in kiloPascal (kPa).¹⁵ The Martin Vigorimeter has been specifically designed for patients with arthritis to allow proper grip strength assessment while avoiding excess stress on weak or painful joints.^{12,16} Although the use of this Martin Vigorimeter is not as widespread as the Jamar, it has been frequently used to assess handgrip strength in clinical practice.^{13,15,17–23} An evaluation of handgrip strength in a healthy older population via the use of the Jamar dynamometer versus the Martin Vigorimeter has confirmed the overall applicability of both methods in the elderly population.^{13,18} In clinically compromised geriatric patients, the use of the Martin Vigorimeter allows the assessment of handgrip strength with minimal requirements for position and optimal capacity for the patients to generate maximal grip in a (for them) comfortable position. We hypothesize that the Martin Vigorimeter is a reliable and more practical tool to assess handgrip strength in the geriatric patient, with test-retest reliability comparable or even better than when using the Jamar dynamometer.

The present study evaluates the applicability and test-retest reliability of measuring handgrip strength with both the Jamar dynamometer and the Martin Vigorimeter in geriatric patients during

hospitalization. A total of 109 geriatric patients were selected on admission to an acute care geriatric ward of a teaching hospital. Handgrip strength was measured 3 times with both devices on 2 separate occasions in acutely ill geriatric patients within 1 week of hospital admission.

Methods

Study Sample

All geriatric patients admitted to the acute care geriatric ward of a large Dutch general hospital were asked to participate in the study. For organizational reasons, there were 3 periods of recruitment: the first from March through June 2012 and the second and third for the same months in 2013 and 2014. The inclusion criteria were age older than 70 years and being frail according to the Groningen Frailty Indicator (GFI).²⁴ Patients were excluded if they had hand deformation, missing fingers, acute arthritis or a fracture of the wrist or hand, and/or were not able to follow instructions because of a severe confusional state or dementia. All patients were informed on the nature of the measurements before written informed consent was obtained from the patient or proxy. This study complied with the guidelines set out in the Declaration of Helsinki and was approved by the Ethics Committee of Sittard-Heerlen, the Netherlands (number 13-N-60).

Patient Characteristics

Patient characteristics were retrieved from the medical and nursing files. These included sex, age, living situation, diagnosed medical conditions, medical history, and activities of daily living (ADLs) before the acute illness that led to hospital admission. Height was estimated to the nearest centimeter by measuring ulna length because many patients were temporarily bedridden.²⁵ The frailty score was assessed according to the GFI criteria, which ranges from 0 to 15: a score of 4 or higher indicates frailty.^{24,26,27} Body weight was measured on a sitting weight scale (SECA, Model 959 [SECA Limited, Birmingham, UK]).



Fig. 1. Jamar dynamometer (left) and Martin Vigorimeter (right) (Copyright W. Sipers).

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