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HAND GRIP STRENGTH AS A POTENTIAL NUTRITIONAL ASSESSMENT TOOL IN LONG-TERM CARE HOMES

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ABSTRACT

Loss of muscle mass and functionality leads to increased risk for falls and onset of frailty, especially residents of long term care (LTC) homes. Hand grip strength (HGS) is emerging as a promising tool to measure muscle strength and a proxy for functionality. Given its promise as a screening tool, several studies report cut-offs below which measured strength was predictive of risk of poor mobility in older subjects. A scoping review was conducted to examine whether HGS was currently being used in LTC, as studies demonstrate hand grip strength as positively correlated with activities of daily living, implying increased dependence on caregivers including mealtimes. Of 19 published studies in 2015, only two report HGS use. As there is an association of grip strength with nutrition-related outcomes, hand grip strength should be used as part of nutritional assessment by dietitians in LTC, as poor muscle strength adversely affects activities of daily living that may impact intake.

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INTRODUCTION

Aging is associated with loss of muscle mass and strength. Poor muscle strength, due to sarcopenia or frailty, results in deficits in physical activities of daily living (PADL) scores and possibly a poor quality of life.[1,2]. As a risk factor, frailty has recently gained attention as an important reason for seniors' loss of independence.[3] These factors may be accompanied by placement in long-term care homes and increased mortality and other comorbidities in older adults.[4] Thus, efforts are made to provide appropriate interventions to preserve functionality and mobility by retaining muscle mass and strength in older adults.[5] Nutritional interventions are key to maintenance or improvement in functionality. Nutritional assessments traditionally relied on biochemical markers to identify malnutrition. Recently, nutritional assessment has undergone a paradigm shift in which functional assessment is used to determine malnutrition.[6] One measure in this new protocol is hand grip strength.[7] Thus, the purpose of this article is determine if hand grip strength is being used in long-term care and to consider whether hand grip strength is an appropriate assessment tool for older adults in long-term care homes.

Search Strategy

We used two methods for this review. In the first, we provide a critical examination of definitions for frailty, sarcopenia, with a focus on older adults and when possible, on adults living in long-term care (also called nursing homes). In the second method, we employ the scoping review methodology as defined by Grant and Booth[8] to "identify nature and extent" of the issue of using hand grip assessment in long-term care. Searching the English language literature throughout 2015 (including epub), and using the search terms "nursing homes AND nutrition assessment" or "long term care AND nutrition assessment", we found, upon reading the title and abstract, 19 unique papers which concerned long term care and evaluation of nutritional status, eating behavior or functionality. Upon reading the full article, two were omitted: one study concerned only constipation assessment, and one study discussed staffing issues. Thus we examined, in detail, 19 articles on nutrition assessment to be discussed below.

Frailty and Sarcopenia

Measurement of the physical activities of daily living (PADL) is based on descriptive questions on how well one can manage day-to-day actions.[9] Older adults may become less independent with increased frailty, which can be measured by the diminished abilities in activities of daily living.[1] Sarcopenia is the state of reduced muscle strength and muscle mass[10] which in turn increases functional limitations.[11] Aging predisposes skeletal muscle to increased levels of oxidative stress, which might have a role in causing sarcopenia-associated muscle loss.[12] As sarcopenia leads to declined physical capacity with aging, it is the most important risk factor for functional status.[13] Preserving physical capacity is crucial to maintaining autonomy, health and quality of life in older adults.[14]

Frailty is prevalent in older adults and a significant contributor of fall incidence.[15,16] The most commonly cited definition of frailty[15] consists of having three or more of the following criteria: unintentional weight or muscle loss, weakness with low hand grip strength, self-reported exhaustion, slow walking speed, and low level of physical activity. Frail individuals are more likely to experience first falls, require more frequent hospitalization, and have higher PADL-dependence.[15]

Sarcopenia contributes to frailty. The European Working Group on Sarcopenia in Older People has defined it as a loss of muscle mass and muscle strength or performance resulting in adverse outcomes and poor quality of life.[17] The pathogenesis of frailty links sarcopenia to health outcomes such as PADL, disability, and falls.[18] Risk factors such as aging, lifestyle, environment, and disease states contribute to chronic

inflammation. Chronic low grade inflammation promotes the development of several age related diseases, [19] such as atherosclerosis, [20] type 2 diabetes, [21] Alzheimer's disease,[22] and osteoporosis.[23] Microscopic changes in muscle due to low-grade inflammation can affect physiological functions through the musculoskeletal system, resulting in sarcopenia, for example. The alterations of functions lead to observable traits as seen in the characteristics of frailty. The so-called frail phenotype contributes to detrimental health outcomes such as falls and PADL disability.[24]

Hand Grip Strength Measurement

The use of hand grip strength is recommended to evaluate an individual's muscle strength.[17,25] The wide application of hand grip strength has gained attention especially in the health care field as a proxy tool for functional assessment. The use of hand grip strength in the algorithms for screening frailty and sarcopenia stresses its increasing application as a functional assessment tool. However, its use remains fairly new to the field of dietetics. Functional impairment is now emphasized over biochemical assessment as the means to assess malnutrition, as put forward in a recent consensus statement through the Academy of Nutrition and Dietetics (AND) and the American Society of Parenteral and Enteral Nutrition (ASPEN). [6]

The generally accepted gold standard for hand grip strength measurement is the Jamar hand dynamometer with high test-retest reproducibility and inter-rater reliability. [26] The test is performed in a seated position using with the subject's shoulders neutrally rotated and elbow flexed at 90° with forearm in neutral position. Both arms are tested, alternately, in triplicate, with the highest value used. Some authors suggest a 5 second interval is sufficient time for the maximal value to be archived. The Jamal dynamometer automatically records the highest strength (kg). However, individuals who were abnormally weak may be unsuitable for this test as the device requires at least 1-2 kg to produce an accurate measurement. [26]

In healthy individuals (age 5-95+ y) measured across the life course using normative data from twelve British studies, [27] males had stronger hand grip strength than females in all age groups above age 5, and hand grip strength peaked at age 30-40 after which it declined with age in both sexes.[27] Other factors related to reduced hand grip strength include acute or chronic complications, disease severity, medical treatment, immobilization, and comorbidity. Obese individuals can exhibit lower grip strength based on body size which is explained by their sedentary lifestyle. [28]

Hand Grip Strength and Functionality

Hand grip strength is closely related to PADL and functional limitations. Community-dwelling older adults with lower hand grip strength were 1.3-2.3 times more likely to develop PADL dependence after a 5-year period.[29] Specifically for males, weaker individuals were more likely to develop disability in dressing and bathing compared to men with greater hand grip strength [30]. Mobility limitations such as walking difficulties and inability to rise from a chair were also used as health outcomes for studies on hand grip strength in older adults. Individuals with weaker hand grip strength experienced more difficulties in walking[31,32] and lesser ability to rise from a chair [33] compared to their strong counterparts. As a result, hand grip strength measurement has become a proxy of functionality.

Hand grip strength threshold values for diagnosis of clinical weakness have recently been published by the Foundation for the National Institutes of Health (FNIH) Sarcopenia Project group. [34] They validated hand grip strength measurements for sarcopenia against a slow walking speed of < 0.8 meters per second as the clinical marker of weakness, using pooled cross-sectional analyses for older adults age ≥ 65 years. [3] Their hand grip strength threshold values of < 26 kg and < 16 kg

for men and women, respectively, are shown in Table 1. Data from previous groups who had published cut-offs for sarcopenia or frailty is also given in Table 1, to indicate a near-consensus on setting these values. Information in Table 1 reflects data of community-dwelling older adults but little work has focused on older adults residing in long-term care homes.

Table 1. Proposed cut-offs for hand grip strength for defining clinical muscle weakness (sarcopenia) validated in community-based populations

Organization	Males (kg)	Females (kg)
CHS: Cardiovascular risk[1]	≤ 30	≤ 17-18
InCHIANTI[2]	< 30	< 20
FNIH: Sarcopenia[3]	< 26	< 16
EWGS [4]	< 30	< 20

[1] Based on definition of frailty; CHS: Cardiovascular Health Study [9], cutoffs for BMI in range of 24.1-28.0 BMI (kg/m^2).
[2] Based on walking speed <0.8 m/s and difficulty walking 1 km; InCHIANTI: Invecchiare in Chianti [25].
[3] Based on walking speed <0.8 m/s; FNIH: Foundation for the National Institutes of Health Sarcopenia Project [34]
[4] Based on "statistical analysis"; EWGS: European Working Group of Sarcopenia. [17]

Nutrition and Hand Grip Strength

The criteria between defining frailty[15] and diagnosing malnutrition as proposed by AND/ASPEN overlap.[6] The presence of two or more of the following six criteria is an indication of malnutrition: insufficient energy intake, weight loss, loss of muscle mass, loss of subcutaneous fat, fluid accumulation, and diminished hand grip strength.[6] In one study, a reduction in hand grip strength correlated with protein loss in patients, and its return to more normal values in response to nutritional repletion was faster than changes in muscle mass.[28] In another study, patients assessed using the Subjective Global Assessment (SGA) tool with grades B and C indicating moderate and severe malnutrition, respectively, had significantly lower percent of ideal grip strength compared to patients with SGA grade A (no malnutrition) as shown in Figure 1.[35] In a study where the Nutrition Risk Screening tool was used for comparison, hospital inpatients who were classified as nutritionally-at-risk had significantly lower hand grip strength ($P<0.001$) compared to those who were well nourished. Considering only individuals age ≥65 years, female subjects had maximum hand grip strength of 16 kg whereas males had maximum hand grip strength of

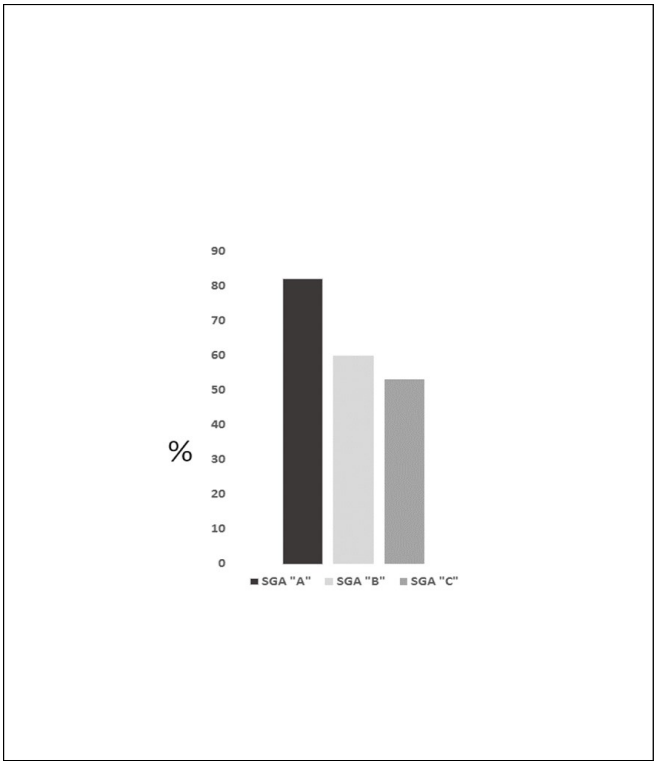

Figure 1 Mean predicted percent of ideal hand grip strength across different subjective global assessment (SGA) categories for hospitalized adults: category A = no malnutrition; category B = moderate malnutrition; category C = severe malnutrition (Diagram modified from [35]). There is a significant difference between means ($P<0.001$) of A vs B and A vs. C.

26 kg,[36] indicating values close to the threshold for clinical weakness. In community dwelling subjects, hand grip strength was not strongly associated with nutritional risk assessed using traditional indicators, but the authors recommend inclusion of hand grip strength into risk screening of community-dwelling older adult.[37] Thus in situations of risk for malnutrition, whether in hospital, in community-dwelling elderly, or in long term care, hand grip strength could play a role in assessment.

Current Practices of Nutrition Assessment in Long Term Care

To determine if hand grip strength was currently in use in long term care homes, we reviewed all studies published (or epub) in 2015 that used nutrition assessment (including food behavior and functional assessments) in long term care. As shown in Table 2, of the 19 studies located, [38-56] only two reported use of hand grip strength.[40-53] Studies were from North America and Europe, with most studies reported nutrition assessment using the MNA, the Mini-Nutrition Assessment tool [57] that uses the following indicators: appetite, swallowing changes; recent weight loss; mobility (defined as not being in bed); stress; neuropsychological problems; body mass index; calf circumference. Of the two studies reporting on hand grip strength use, one was a research study, but interestingly classifies hand grip strength as being a nutrition indicator being measured by dietitians.[40] The other article with hand grip strength was an exercise training intervention and not involving dietitians.[53]

Current best practice for nutrition assessment in Canada is described in working paper as including the following elements: current height and weight status, and historical weight data if available; current diet, food texture, fluid consistency needs; dietary history and current documented food and fluid intake; use of supplements; review of relevant conditions and diagnoses, including those known to be of particular risk to this population; review of physical and cognitive functioning; review of eating ability and need for assistance; examination for skin integrity; review of gastrointestinal/bowel function/issues; review of significant lab values; review of medications and potential food-drug interactions; review of intake of vitamins/minerals; dentition; allergies and/or food intolerances; daily nutritional requirements.[58] While functional assessment is an important component, hand grip strength is not specifically mentioned, and it appears that "functional" assessment is not objectively measured.

Limitations of Measurement

In clinical practice the use of handgrip strength has important limitations. No study or guideline has published measurement protocols.

Clinical studies usually report the highest value achieved after triplicate measures[26] to allow for subjects to have one arm with an affliction due to arthritis or stroke. However, consistency in measuring hand grip strength appears to be important, with posture and handle position as important determinants of precision.[27] In long-term care, frail individuals may have more difficulty in assuming proper positioning. The cognitive status of the subject may preclude accurate measurement as poor cognition may affect hand grip strength performance.[59,60] This may be due to an inability of the subject to understand instructions to squeeze as hard as possible. Those with depression may also fail to perform optimally, although this has not been reported in studies. However, it must be noted that most studies have validated hand grip strength using cross-sectional data of community-dwelling adults (Table 1).

SUMMARY

The use of hand grip strength as a nutritional assessment tool remains novel to dietitians for use in practice but recent recommendations encourage its use. Hand grip strength used as part of a nutritional assessment is recommended as a screening tool to

Table 2. Scoping review of articles (research studies or reviews)

Study first author and reference number	Country	Nutrition Assessment Methodology	Nutrition Assessment Indicators	Use of Hand Grip (yes/No)
Madeira [38]	Portugal	MNA	BMI	No
			Calf circumference	
Cedera [39]	Italy	MNA	BMI	No
			Calf circumference	
Beck [40]	Denmark	BMI	BMI	Yes
		HGS	HGS	
Pezzana [41]	Italy	MNA	BMI	No
			Calf circumference	
Ongan [42]	Turkey	MNA	Waist, hip, calf	No
		24-h recall	Circumference;	
		Anthropometrics	waist/hip ratio,	
			mid-upper arm circumference	
			BMI	
Nazemi [43]	Iran	MNA	BMI	No
			Calf circumference	
Lilamand [44]	France	MNA	BMI	No
			Calf circumference	
Meyer [45]	Germany	MNA	BMI	No
			Calf circumference	
Muurinen [46]	Finland	MNA	BMI	No
			Calf circumference	
Beck [47]	Denmark	MNA	BMI	No
			Calf circumference	
Torma [48]	Sweden	MNA	BMI	No
			Calf circumference	
Keller [49]	Canada, Denmark	Food intake	--	no
Borgstrom [50]	Sweden	MNA	BMI	No
			Calf circumference	
Bell [51]	USA	GNRI, MNA, MNASF, MUST, NRS, SNAQ	BMI	No
			Calf circumference	

Table 2 continuation next page...

Table 2 continuation...

Study first author and reference number	Country	Nutrition Assessment Methodology	Nutrition Assessment Indicators	Use of Hand Grip (yes/ No)
Pouyssegur [52]	France	MNA	Weight change, BMI, calf circum-ference,	No
			Pressure ulcers	
Aartolahti [53]	Finland	BMI	BMI, Berg balance	Yes
			Timed up and go	
			Hand grip strength	
Liu [54]	USA	Oral intake	Eating performance (self-feeding)	No
Brooke [55]	United King-dom	Serum albumin	Pressure sores	No
Kelaiditi [56]	France	Diet history or food frequency questionnaires; MNA	BMI	No
			Frailty assessment	

BMI, body mass index; GNRI, Geriatric Nutritional Risk Index; MNA, Mini-Nutritional Assessment; MNA-SF, mini-nutritional assessment – short form; MUST, malnutrition universal screening tool; NRS, nutritional risk screening; SNAQ, Short Nutritional Assessment Questionnaire

identify individuals at high risk of malnutrition. When measured values fall below 26 kg and 16 kg, for adult males and females, respectively, this indication of clinical weakness should signal need for further nutrition assessment. Long-term care residents with weaker hand grip strength may signal health providers of their increased risk of reduced functionality and possible frailty.

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