Clinical Nutrition (2008) **27**, 357—362

available at www.sciencedirect.com

ScienceDirect

http://intl.elsevierhealth.com/journals/clnu

ORIGINAL ARTICLE

Reference values and determinants for handgrip strength in healthy subjects☆

Michele Berçôt Budziareck*, Rodrigo Roig Pureza Duarte, Maria Cristina G. Barbosa-Silva

Programa de Pós-graduação em Saúde e Comportamento, Universidade Católica de Pelotas, Pelotas, RS, Brazil

Received 5 June 2007; accepted 21 March 2008

KEYWORDS
Nutritional assessment;
Muscular function assessment;
Handgrip strength;
Dynamometry;
Adductor pollicis muscle;
Reference values

Summary
Background & objectives: To determine reference values and associated factors for handgrip strength among healthy adults.
Methods: Three hundred well nourished (SGA category A) subjects were studied, aged 18—90 years. Handgrip strength (HS) was determined using a hand dynamometer. Adductor pollicis muscle (APM) thickness and other anthropometric variables were also measured. Results were analyzed according to gender and age group. We carried out multiple linear regression in order to identify significant determinants of handgrip strength.
Results: HS is significantly associated with gender and decreases after age 60 years ($p < 0.001$). Different reference values for each gender and age category are presented, for both dominant (DHS) and non-dominant hands (NDHS). APM showed a strong correlation with HS ($R^2 = 0.71$ and 0.70, for DHS and NDHS, respectively). This association remained significant after adjustment for other variables such as gender, age and body mass index.
Conclusion: Reference values are needed to allow the use of HS as a muscular function assessment tool. Values should be stratified by gender and age group. The combined use of HS and APM may be useful as a method for nutritional assessment.

Introduction

In the last 20 years, a number of scientific publications from around the world point to hospital malnutrition as a direct cause for higher morbidity (slower wound healing; higher hospital infection rates; longer stay, especially among

☆ This work was partially funded by CAPES, Ministry of Education, Brazil.
* Corresponding author. Programa de Pós-graduação em Saúde e Comportamento, Universidade Católica de Pelotas, R. Santos Dumont, 504A, 96020-380 Pelotas, RS, Brazil. Tel.: +55 53 3225 1243.
E-mail address: michelebercot@yahoo.com.br (M.B. Budziareck).

0261-5614/$ - see front matter
doi:10.1016/j.clnu.2008.03.008

intensive care patients; higher readmission rates) and mortality.[1] The obvious impact of such a scenario include avoidable deaths, additional costs for the social security system, and the social onus related to loss of working days.[2] Other variable in this equation is increased expenditure for the healthcare system.

A wide variety of methods are available for nutritional evaluation. Notwithstanding, none of these can currently be considered as a ''gold-standard'' for diagnosing hospital malnutrition.[3] Available methods include anthropometry, the creatinine height index, albumin, pre-albumin, immunocompetence evaluation, cholesterol, and the prognostic nutritional index, among others.[4] However, none of these methods provides a functional evaluation of malnutrition. SGA is a well accepted method of nutritional assessment that addresses functional status as a complement of its medical history, but it was not developed to be used to evaluate responsiveness, and so, its rating are not expected to show any modification after nutritional interventions in short periods of time.[5]

There is evidence that muscular function is altered and muscular strength diminished, in the presence of malnutrition.[6,7] According to Jeejeebhoy,[4] malnutrition-related muscular function alterations appear before changes in anthropometric and laboratory parameters. Nevertheless, methods for evaluating muscular strength during nutritional evaluation are still scarce.[8]

The earliest nutritional alterations occur within muscle cells, and have an effect on muscle cell function. Measuring muscular strength may therefore provide a sensitive method for nutritional evaluation.[9] Muscular loss is inevitable during malnutrition, and if untreated, may become progressive.[10] Therefore, in addition to their ability to detect early alterations related to malnutrition, muscular function tests could also prove useful for evaluating nutritional recovery, underscoring the importance of such evaluation in this context.

Recent studies have demonstrated the validity of using hand dynamometers as a method for nutritional evaluation, given that this is a simple, fast, useful, inexpensive, and efficacious test for muscular function.[11–14] Knowledge of reference values in a healthy population would allow a functional muscle evaluation not only in hospital and research settings, but also in population-based studies, since this is a simple and low-cost assessment method.

The two other papers with reference values had 108 subjects[9] and 496 subjects,[13] but they don't have similar distribution among the age categories and used different tools for the assessment of handgrip strength. The aim of the present study was to determine reference values for handgrip strength (HS) in a more homogeneous sample of healthy adults, as well as to study the influence on this parameter of variables such as gender, age, professional activity, and adductor pollicis muscle (APM) thickness.

Methods

Selection lasted from April to September 2006. The study had a cross-sectional design, and was carried out at the *Hospital Universitário São Francisco de Paula* (HUSFP) and at the *Centro de Extensão em Atenção à Terceira Idade* (CETRES), a communal center for older people. We also collected data at a local city square, due to the difficulty in recruiting male volunteers over 60 years of age in the two previous locations.

Subject recruitment procedures differed between each location. At HUSFP, we obtained an ordered list of the entire hospital staff and selected the necessary number of participants under 60 years old (200) using a random selection process (random list generated by Stata). At CETRES, we selected 11 of the 23 ongoing workshops, and, within each of these workshops, participants were randomly selected until the necessary number of subjects was obtained (50). Finally, at the local city square, after subjects agreed to participate, each volunteer was randomly assigned to participate or not in the study, so as to avoid selection bias. After the selection process, we invited to participate in the study three hundred healthy volunteers (150 men and 150 women) aged 18–90 years.

Following the selection process, volunteers were invited to participate in the study. Those who agreed to participate were informed about the study's methods and objectives. After accepting to participate, all subjects signed a term of informed consent. As inclusion criteria, all patients should be healthy as assessed by Subjective Global Assessment (SGA A). We excluded from this study subjects under the age of 18 years and those unable to perform the strength measurements.

Nutritional evaluation of subjects was carried out using subjective global assessment (SGA).[15] This method was performed by dieticians previously trained in the technique, since it depends on the evaluator's observational abilities. HS was measured using a Jamar® hydraulic hand dynamometer (Asimow Engineering Co., Los Angeles, CA), and APM thickness was measured using a Lange® skinfold caliper.

Initially, we administered a questionnaire to obtain additional information, including age, weight, height, and occupation, the latter considering two distinct professional groups, one in which manual physical effort is inherent to professional activity, and one in which it is not. Sports activities, dominant hand, and presence of injuries and/or fractures in any of the hands were also considered as relevant data, given that these may influence the final results. HS and APM were also measured at this time. The economic classification criterion by the Brazilian Market Research Association (*Associação Nacional de Empresas de Pesquisa* — ANEP was used. The criterion is based on the ownership of consumer goods, presence of domestic servants and on the schooling of the household head and group the individuals into one of five classes, from A (richest) through E (poorest).

HS and APM evaluation was carried out with the subject in a standardized position. For HS evaluation, subjects were seated, with their elbows flexed at 90° and supported at the time of the measurement.[16] We collected three measurements from each hand, and used the mean value in all analyses.[13] During HS measurement, we asked the subject to grip the dynamometer with maximum strength, and to hold the grip for three seconds. For APM evaluation, subjects were seated with both hands resting on the homolateral knee, and elbows flexed at approximately 90°, over the lower limb. The APM was pinched by the skinfold caliper at the vortex of an imaginary angle formed by the