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Correlation between manual muscle strength and interleukin-6 (IL-6) plasma levels in elderly community-dwelling women

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ABSTRACT

Sarcopenia is a loss of muscle mass related to aging and leads to muscle performance decline. An increase in inflammatory mediator levels, especially of IL-6, has been associated to reduced muscle strength in the elderly. The aim of the present cross-sectional study was to correlate IL-6 plasma levels with manual muscle strength (MMS) in 63 community-dwelling elderly women. (71.2 ± 7.4 years). IL-6 was measured using enzyme-linked immunosorbent assay (ELISA) and MMS was measured using the JAMAR dynamometer. Pearson's test was used to explore the relationship between the outcomes at the significance level of $\alpha = 0.05$. IL-6 levels (2.56 ± 3.44 pg/ml) and MMS (22.86 ± 4.62 kgf) exhibited an inverse correlation ($r = -0.2673$ and $p = 0.0373$). The increase in IL-6 plasma levels possibly contributed toward the reduction in manual muscle strength among the elderly women studied.

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1. Introduction

Physical disability often occurs in the elderly. It is estimated that between 20 and 30% of individuals over 70 years of age who reside in the community experience disabilities in performing basic and instrumental activities of daily living that require mobility and locomotion (Lima-Costa et al., 2003). Sarcopenia is defined as a loss of muscle mass related to aging and contributes toward the loss in functional mobility as well as loss of independence. It has been proposed that sarcopenia should be considered a public health problem for the female gender, as women live longer and exhibit higher levels of disability (Doherty, 2003).

The IL-6, which is known as the 'geriatric cytokine', is a multifunctional cytokine produced in situations of trauma, stress and infection. During the aging process, IL-6 plasma levels become elevated. The natural induction of cytokines is likely beneficial during inflammation, but overproduction and the maintaining of an inflammatory state for longer periods of time, as seen in elderly individuals, is detrimental to the organism (Ershler and Keller, 2000; Krabbe et al., 2004). A number of authors have demonstrated that a rise in pro-inflammatory cytokine plasma levels, especially IL-6, and proteins in an acute condition are associated to a reduction in mobility as well as a reduced capacity to perform activities of daily living, the development of fragility syndrome and increased mortality rates (Ferrucci et al., 1999; Ershler and Keller, 2000; Leng et al., 2002; Cappola et al., 2003; Cohen et al., 2003; Krabbe et al., 2004; Penninx et al., 2004).

The reduced ability to perform functional daily activities among elderly individuals with high levels of IL-6 occurs, in part, as a result of sarcopenia (Ferrucci et al., 2002), which is influenced by the reduction in trophic stimuli stemming from innervation and hormonal functions as well as by an increase in the catabolic effects of inflammatory cytokines (Roubenoff, 2003). This loss in muscle strength is exacerbated by reduced caloric and protein intake as well as reduced physical activity in the elderly (Roubenoff, 2003). Haddad et al. (2005) have demonstrated that there is an atrophy in the anterior tibia muscle of mice following the injection of relatively low doses of IL-6, suggesting that IL-6 may cause functional decline by means of catabolic effects in the muscle (Haddad et al., 2005).

The measurement of hand muscle strength provides an estimate of strength in all muscle groups (Rantanen et al., 2003) and it has been showed that it is able to predict reductions in functional capacity and mobility (Lauretani et al., 2003) as well as falls (Nevitt, 1997) and even death (Rantanen et al., 2003) among the elderly. One study demonstrated that high levels of IL-6 were associated to a two- to threefold greater risk of losing 40% of grip strength (Schaap et al., 2006). Thus, the aim of the present study

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was to determine the relation between IL-6 plasma level and grip strength in community-dwelling elderly women.

2. Subjects and methods

The present observational, cross-sectional study was carried out on a sample of elderly women who reside in the community of Belo Horizonte Municipality, Brazil. The project was approved by the Research Ethics Committee of the Universidade Federal de Minas Gerais (No. 188/05).

2.1. Sample

A convenience sample of 63 elderly women (71.2 ± 7.4 years) was selected. All subjects resided in the community and have preserved cognitive function. The sampling calculation was based on a study by Penninx et al. (2004). The exclusion criteria were: acute inflammatory condition or active neoplasm in the previous 5 years; use of medication with broad-based action on the immune system; hand deformity that impeded the performance of the grip strength test; and cognitive alterations detected by the mini-mental state examination (MMSE) (Folstein et al., 1975; Bertolucci et al., 1994).

2.2. Procedures

Following a training session, the researchers administered a questionnaire in order to characterize the sample with regard to socioeconomic data, health aspects and living habits.

2.3. IL-6 measurement

Five milliliters of blood were collected from the ulna vein of the participants in Vacutainers with citrate by a qualified healthcare professional, complying with the norms for the use of sharp instruments in an aseptic environment. The blood was then centrifuged and the plasma was removed in a sterile environment and stored in Eppendorf tubes in a freezer at −30 °C. Analysis of IL-6 plasma concentrations was performed through ELISA, using high-sensitivity kits (Quantikine®HS, R&D Systems Minneapolis, USA). The results of the IL-6 plasma levels are presented in picograms per milliliter (pg/ml). Readings were performed by a single microplate reader adjusted to 490 nm and wavelength correction at 650 nm at the Immunopharmacology Laboratory of the Biological Sciences Institute of the University.

Table 1
Characteristics of the elderly women ($n = 63$)

Variables	Characteristics	Average ± S.D. or frequency (%)
Socioeconomic	Age (years)	71.2 ± 7.4
	Marital status (single)	6 (9.5)
	Schooling (years)	6.6 ± 4.5
	Income (MS)	3.59 ± 4.13
Health	BMI	27.36 ± 4.37
	No of chronic illnesses	2.57 ± 1.63
	Number of medications taken	1.98 ± 1.54
	Worst mobility	3 (4.8)
	Health complaint (yes)	21 (33.3)
	Pain (yes)	34 (54)
	Falls (yes)	16 (25.4)
Living habits	Number of visits to the doctor/year	2.11 ± 1.18
	Physical activity (yes)	41 (65.1)
	Physical therapy (yes)	3 (4.8)
	Leisure activities (yes)	53 (84.1)

MS = income calculated by a factor of the minimum monthly salary in Brazil, BMI = body mass index. Worst mobility = walk with human assistance or brace.

2.4. Measurement of hand muscle strength

For the measurement of hand muscle strength, the JAMAR® dynamometer (model PC5030JI) was used, which is a valid, reliable instrument of easy application for detecting maximum grip strength (Mathiowetz et al., 1985). Participants were seated with their feet resting on the floor, hips and knees at 90° of flexion, and without arm supports. The shoulders were in the adduction and neutral rotation position. The elbow was positioned at 90° flexion, with the forearm and wrist in neutral positions (Gutierrez and Shechtman, 2003). Participants were asked to perform three maximum grip motions with 1 min of rest between them. The results are presented in kilogram-force (kgf) as the average of three measurements ± S.D. (Haidar et al., 2004). The dynamometer was adjusted to 2° or 3° of space according to what was most comfortable for the participant, as maximum grip nearly always occurs in these positions (Westbrook et al., 2002).

2.5. Statistical analysis

Descriptive analysis was used to characterized the sample with regard to socioeconomic, health variables, and living habits, employing central tendency and dispersion measures (average and standard deviation) for quantitative variables and frequency measures for categorical variables. The hypothesis of data distribution normality was assessed both descriptively and by the Shapiro-Wilk test. As normal distribution was not observed for the IL-6 plasma levels, this variable underwent logarithmic transformation and the Pearson's coefficient was used to assess the correlation between IL-6 and handgrip strength. The significance level was set at $\alpha = 0.05$. The Statistical Package for the Social Sciences (Version 13 for Windows) was used.

3. Results

Sixty-three elderly women with an average age of 71.2 ± 7.4 (in the range of 60–88 years) and residing in the community participated in the study. Table 1 displays the socioeconomic and health characteristics, as well as living habits.

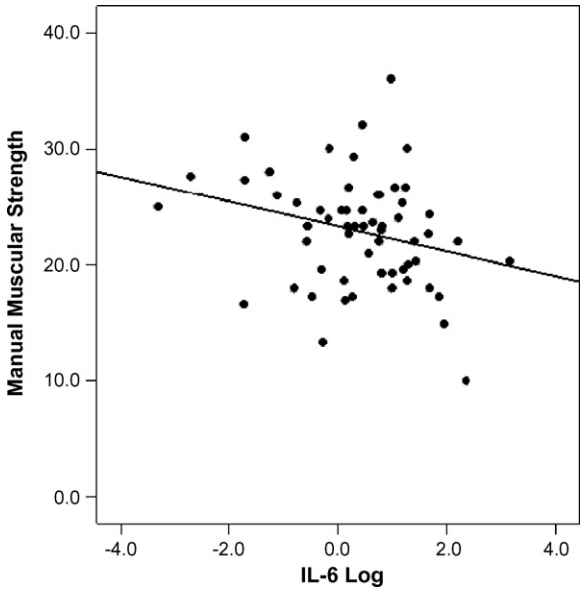

Fig. 1. Correlation of IL-6 plasma levels and MMS in elderly women residing in general community ($n = 63$), using a logarithmic transformation of the IL-6 values. Pearson's correlation analysis reveals an inverse correlation between IL-6 and MMS of the elderly women residing in the community ($r = -0.2673$; $p = 0.0373$).

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