Archives of Gerontology and Geriatrics 78 (2018) 18–22

Contents lists available at ScienceDirect

Archives of Gerontology and Geriatrics

journal homepage: www.elsevier.com/locate/archger

The relationship between masseter muscle thickness and appendicular skeletal muscle mass in Japanese community-dwelling elders: A cross-sectional study

Kento Umeki[a], Yutaka Watanabe[b,c,*], Hirohiko Hirano[a,b], Ayako Edahiro[b], Yuki Ohara[d], Hideyo Yoshida[b], Shuichi Obuchi[b], Hisashi Kawai[b], Masaharu Murakami[b], Daisuke Takagi[e], Kazushige Ihara[f], Kentaro Igarashi[g], Masayasu Ito[a], Yasuhiko Kawai[a]

[a] Department of Removable Prosthodontics, Nihon University School of Dentistry at Matsudo, Matsudo, Chiba, 271-8587, Japan
[b] Tokyo Metropolitan Institute of Gerontology, Itabashi, Tokyo, 173-0015, Japan
[c] National Center for Geriatrics and Gerontology, Obu, Aichi, 474-8511, Japan
[d] Department of Oral Health Care Education, Graduate School of Medical and Dental Sciences, Tokyo Medical and Dental University, Tokyo 113-8510, Japan
[e] Department of Critical Care Medicine and Dentistry, Division of Medically Compromised Geriatric Dentistry Graduate School of Dentistry, Kanagawa Dental University, Yokosuka, Kanagawa, 238-8580, Japan
[f] Department of Public Health, Toho University School of Medicine, Tokyo, 143-8540, Japan
[g] Nihon University Graduate School of Dentistry at Matsudo, Matsudo, Chiba, 271-8587, Japan

ARTICLE INFO

Keywords:
Sarcopenia
Masseter muscle thickness
Skeletal muscle index
Community-dwelling elders

ABSTRACT

Purpose of the study: Sarcopenia has been identified as a health hazard in elderly people. Although the association between sarcopenia and a decrease in masticatory function has been reported, the mechanism underlying this association has not been widely reported. Therefore, in order to elucidate the relationship between sarcopenia and masticatory function, we examined whether the masseter muscle thickness (MMT), which is a factor influencing masticatory function, in community-dwelling elders is associated with the appendicular skeletal muscle index (SMI), a diagnostic criterion for sarcopenia.

Materials and methods: MMT was measured in 774 community-dwelling elders aged 65 years or older at resting state via ultrasonography, and SMI was measured with the bioelectrical impedance method. The relationships were investigated by calculating Pearson's correlation coefficients. Multiple regression analyses adjusted for age and sex, SMI, and oral-related items were performed to determine the association between these factors.

Results: There was a significant correlation between the MMT and the SMI. The multiple regression analysis indicated that SMI was significantly associated with a decrease in MMT.

Conclusions: The reduction in whole-body skeletal muscle mass in sarcopenia may be involved in the reduction in MMT. Prevention of sarcopenia may be an important factor for maintaining masticatory function in the elderly.

1. Introduction

Sarcopenia, a concept proposed by Rosenberg in 1989 (Rosenberg, 1989), is related to health problems and is an impediment in the activities of daily living (ADL) for the elderly (Janssen, Baumgartner, Ross, Rosenberg, & Roubenoff, 2004). Its main symptoms are a decrease in whole-body skeletal muscle mass and strength, and a number of factors, such as nutrition, exercise and disease, are associated with these symptoms (Cruz-Jentoft et al., 2010).

The masticatory muscles of the head and neck include four skeletal muscles: masseter, temporalis, and the lateral and medial pterygoid muscles (Ide, 2010). The masseter muscle plays a primary role in generating occlusal force (Fukamizu, Kodama, Moriya, Yokoyama, & Murata, 1972). As sarcopenia is associated with a reduction in the whole-body muscle mass, it is suspected to show similar effects on the masseter muscle as well. Prior studies have suggested an association between the decline in masticatory function and the incidence of sarcopenia (Murakami et al., 2015b). However, the mechanism underlying

Abbreviations: ADL, activities of daily living; AWGS, Asian Working Group for Sarcopenia; BIA, bioelectrical impedance analysis; BW, body weight; MMT, masseter muscle thickness; QT, quadriceps thickness; SMI, skeletal muscle index; TMIG, Tokyo Metropolitan Institute of Gerontology

* Corresponding author at: Tokyo Metropolitan Institute of Gerontology, 35-2 Sakae-cho, Itabashi-ku, Tokyo 173-0015, Japan.
E-mail address: ywata@tmig.or.jp (Y. Kawai).

https://doi.org/10.1016/j.archger.2018.05.014
Received 30 October 2017; Received in revised form 7 May 2018; Accepted 28 May 2018
Available online 29 May 2018

this association is unclear as there are no reports thoroughly examining the association between masticatory function and sarcopenia.

Conversely, for the maintenance and recovery of masticatory function, the number of existing teeth and occlusion are considered important. In Japan, since 1989, there has been a national campaign called the “8020 movement”, which addresses the dental health of the geriatric population. This campaign aims to maintain at least 20 teeth within the mouth of elderly individuals aged up to 80 years. The outcomes of this campaign have been sufficiently recorded in recent years (Moriya, Ando, & Miyura, 2011).

However, despite maintaining the number of teeth and occlusion, reduced functioning of factors other than teeth, such as the tongue, and the resultant difficulty in chewing has been reported (Kikutani et al., 2009). This can be attributed to sarcopenia. If the detailed association underlying such reductions can be determined, clinicians will be able to predict a decrease in masticatory function via a decrease in ADL, and manage not only the maintenance and recovery of the number of teeth and occlusion, but also treatment in terms of whole-body function.

The main symptom of sarcopenia is a decrease in muscle mass, and measurement of masseter muscle thickness (MMT) can be useful in estimating masseter muscle mass. Therefore, this study examined the association of the MMT, which is associated with masticatory function, with the skeletal muscle index (SMI), a diagnostic criterion for sarcopenia, in community-dwelling elders.

2. Materials and methods

2.1. Participants

Among the 791 elderly people who participated in an arrival-type medical examination held at Tokyo Metropolitan Institute of Gerontology (TMIG) in October 2013, examinations were planned for the 774 (average age, 73.5 ± 5.6 years old; 329 men, 445 women) participants older than 65 years who lived in Itabashi ward, Tokyo, whose necessary data were complete. The subjects were randomly selected from the Basic Resident Register of 7083 men and women aged 65 to 86 years old who lived in the neighborhood of the TMIG. A letter of invitation was sent to 1471 people, except nursing facility residents. Because the participation was arbitrary, a total of 791 participants finally underwent the medical examinations.

2.2. Measurements

The oral-related assessments were performed by four investigators who conducted the calibration between estimators after a 2-h training session. The selection of items other than the primary investigation items in the present study was performed on the basis of previous studies of oral function and skeletal muscle mass in the elderly (Murakami et al., 2015a; Murakami et al., 2015b).

2.2.1. Main investigation item

2.2.1.1. Basic characteristics. Information regarding the gender and age of the participants was collected via a self-reported survey.

2.2.1.2. SMI. The appendicular skeletal muscle mass was measured with a body composition analyzer (InBody®720; InBody, Seoul, Korea) using the bioelectric impedance method. The total appendicular skeletal muscle mass was divided by the square of the height (m) in order to calculate the SMI.

2.2.1.3. MMT. As described in a previous study (Ohara et al., 2013), MMT was measured by using an ultrasonography device (Miru-Cube; Global-health, Kanagawa, Japan). MMT measurements were obtained with the participant in a relaxed state. After palpation of the masseter muscle, the probe was applied to the muscle, which is located on the extension line of the corner of the mouth, in parallel with the mandibular plane. Measurements were performed twice and mean MMT was calculated.

2.2.2. Other items of investigation

2.2.2.1. Quadricep thickness. Quadricep thickness (QT) was measured with the Miru-cube according to a previously described method (Obuchi, Arai, Kojima, Kawai, & Kojima, 2009). Participants were asked to sit on a chair with their knee bent to 90°. The probe was placed perpendicularly, in the direction of the muscle, approximately 10 to 15 cm from the knee to measure the QT.

2.2.2.2. Number of existing teeth. The number of existing erupted teeth, excluding the residual roots, was counted.

2.2.2.3. Number of functional teeth. The number of existing teeth and the number of prosthetic treated bridges, removal dentures, and dental implants at defect sites were counted.

2.2.2.4. Eichner index. The occlusal contact zones of the existing maxillary and mandibular teeth were classified by the Eichner index (Eichner, 1955). All participants were classified in groups A, B, and C by the classification system.

2.2.2.5. Occlusal force. Occlusal force was measured using bite force measurement systems (Dental-Prescale 50H, and Occluser, GC, Tokyo, Japan). A sensor film was inserted into the oral cavity in between the maxillary and mandibular dentition. The participants then clenched the film with maximal occlusal force (Matsui, Ohno, Michi, Suzuki, & Yamagata, 1996).

2.2.2.6. Masticatory performance-evaluating gum. A color-changeable chewing gum (masticatory performance-evaluating gum; Lotte, Tokyo, Japan) was used to examine the chewing ability. The chewing gum was chewed freely for 1 min and released from the mouth (Kamiyama, Kanazawa, Fujinami, & Minakuchi, 2010). Assessments were performed by testers according to a color chart with five levels (Hama, Kanazawa, Minakuchi, Uchida, & Sasaki, 2014; Tarkowska, Katzer, & Ahlers, 2017).

2.3. Statistical analysis

For MMT and other items, correlations among the items were confirmed by Pearson's correlation coefficient. In order to examine the relevant factors for MMT, multiple regression analysis (forced entry method) was used with MMT as the dependent variable and SMI, QT, Eichner index, occlusal force, and gum score as the independent variables. Age and sex were also included as confounding factors among the independent variables. Multicollinearity was avoided by selecting one item when the correlation coefficient was 0.8 or more between two variables. As age and sex were confounding factors, they were entered into the multiple regression analysis, regardless of the significance level. SPSS Statistics 20.0 (IBM corporation, USA) was used for all analyses, and the significance level was defined as $P = 0.05$.

2.4. Ethical approval and consent to participate

This study was carried out with the permission of the TMIG Ethics Committee (no. 23–1253 in 2011) and Nihon University School of Dentistry at Matsudo Ethics Committee (no. EC14-027 in 2014). Oral explanations were provided to the participants, and written consent was obtained prior to investigation.