

Geriatric Characterization of Older Persons with Deficient Removable Dental Prostheses

Caracterización Geriátrica de Personas Mayores con Prótesis Dentales Removibles Deficientes

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ABSTRACT: Aging is a gradual and adaptive process that entails a series of changes, leading to reduced functional and physiological capacity. Each elderly person presents heterogeneous health conditions that must be considered by the interdisciplinary team responsible for their functional maintenance and overall health. This descriptive, cross-sectional study was conducted on elderly individuals with deficient removable dental prostheses, treated at the dental prosthetic rehabilitation centre of Hospital Del Salvador, in Santiago de Chile between the years 2021 and 2023. Instruments and indices were used to record and measure muscular conditions, such as the hand grip strength measurements, the Timed Up and Go test, and the calf circumference measurement. Information on educational levels, geriatric syndromes, chronic diseases, and medication consumption was collected. Of the participants, 58.9 % were female, and 41.1 % were male, with a mean age of 84.2 years for males and 80.4 years for females. 20.8 % had access to higher education, and 22.6 % lived alone. 78.5 % had lost all posterior support zones. 81.5 % had visual impairments; 36.3 % had auditory impairments, and 31.5 % had experienced one or more falls in the last 6 months. The mean sum of medications consumed per person was 4.32. The most prevalent morbidities were arterial hypertension (66.4 %) and type II diabetes (32.7 %). Means values for male/ female were: Hand Grip Strength 27.84 Kg/17.99 kg, Timed Up and Go 14.3 sec/14.9sec, BMI 27.16/ 26.44, and calf circumference 35.5 cm /35.2cm, values were within the normal range of values. The data collected is important to consider when treatment planning and implementing actions aimed at maintaining oral and general functionality. These aspects should be addressed from a multidimensional perspective, including risk factors, in both the diagnosis and dental treatments.

KEY WORDS: aging, frailty, elderly, dental prostheses.

INTRODUCTION

The global population is aging at an accelerated pace. Between 2015 and 2050, the percentage of individuals aged 60 and older will double, increasing from 12 % to 22 % of the world's population (World Health Organization, 2022). Chile is not exempt from this phenomenon, and according to estimates and projections by the National Institute of Statistics in the 2017 Census, the age group with the highest increase is that of people aged 60 and above (Rojas *et al.*, 2022).

Aging is a gradual and adaptive process that involves a series of anatomical, physiological, morphological, biochemical, and psychological changes

over time, which reduces the functional and physiological capacity of the body (Dalgaard *et al.*, 2022). This process results in elderly patients presenting heterogeneous health conditions that must be considered if they undergo treatment within different medical disciplines, all of which should aim to maintain or improve functionality and health in older individuals. Functionality is a highly predictive factor of health conditions in geriatrics and is generally considered the capacity to perform everyday activities and maintain independence, with activities of daily living (ADLs) being the variable, including basic ADLs (BADLs), instrumental ADLs (IADLs), and advanced ADLs (Echeverría *et al.*, 2022).

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Geriatric syndromes are common clinical conditions in older adults that share underlying causal factors and involve multiple organ systems. These include a range of clinical conditions that, unlike traditional syndromes, do not fit into a discrete disease category. Studies have shown a relationship between a higher number of geriatric syndromes and functional decline (Bell *et al.*, 2016).

One significant geriatric syndrome is frailty, which represents a progressive decline in multiple physiological functions and is defined as a state of increased vulnerability to stress, leading to an increased risk of dependency, functional impairment, hospitalization, and mortality in older adults (Vellas *et al.*, 2017). Consequently, preventing frailty has become a global priority, as efforts in this area can reduce levels of dependency, institutionalization, the need for long-term care, and medical/social expenses (International Association of Gerontology and Geriatrics, 2017). It requires the attention of the entire healthcare team treating older individuals, with special attention to interdisciplinary signs (Abizanda *et al.*, 2014).

To holistically engage with older individuals, dentistry must incorporate various dimensions of geriatrics. For this purpose, the Comprehensive Geriatric Assessment can be utilized. This evaluation process provides information about the medical, functional, and biopsychosocial status of older individuals (Briggs *et al.*, 2022). In Chile, one of the assessment tools used is the Elderly Preventive Medicine Exam (EMPAM), which is conducted at Primary Health Care Centres (APS) for all individuals aged 65 and older once a year to evaluate their overall health and functionality (Muñoz Silva *et al.*, 2015; Wang *et al.*, 2022).

Interdisciplinary teams should be involved in monitoring, and dentistry should not be an exception (Kassebaum, 2022). Clinical decisions should be oriented towards individual characteristics, with treatment protocols considering the risks and impact that geriatric conditions may have on dental treatment outcomes and vice versa, along with defining maintenance schemes for overall and oral functionality based on individual frailty risk factors.

Dental Loss in the Chilean Population and Masticatory Capacity: According to the National Health Survey 2016-2017, 62.2 % of the Chilean population has partial tooth loss, and 5 % are completely edentulous. Among individuals aged 65 to 74 years, 79.8 % are partially edentulous, and among those aged

75 years or older, the percentage is 57.8 %. Completely edentulous individuals account for 17.6 % and 41.2 % in the respective age groups (Ministerio de Salud, 2019). In terms of masticatory capacity, shortened dental arches with intact premolar regions and at least one pair of occlusal molars provide sufficient masticatory function. In extremely shortened arches, masticatory capacity is severely affected (Sarita *et al.*, 2003).

Eichner Index and Oral Functionality: The Eichner Index measures the number of occlusal contact zones between existing natural teeth or fixed prostheses in the premolar and molar regions (Nakatsuka *et al.*, 2010). It consists of three main categories, labeled A, B, and C, each of which further subdivides into subcategories labeled with a letter followed by a number. Category A includes subdivisions A1 to A3, characterized by having four or more posterior occlusal contact zones despite tooth loss. Category B includes four subdivisions: B1, with three posterior occlusal contact zones; B2, with two posterior occlusal contact zones; B3, with one posterior occlusal contact zone; and B4, where both dental arches have partial edentulism, but there are no posterior occlusal contact zones, only anterior contact. Lastly, Category C includes C1, where both dental arches are partially edentulous without any occlusal dental contact; C2, where one dental arch is completely edentulous, and the other is partially edentulous; and C3, where both dental arches are completely edentulous.

The Eichner Index assesses the transition of functional loss from patients with preserved oral functionality in Category A, progressing to Categories B and C, which result in complete tooth loss (Eichner, 1955). These categories start to impact oral functionality, and in the Chilean public health system, a high percentage of individuals are rehabilitated with removable dental prostheses (Goyano Mac-Kay *et al.*, 2015).

In the context of health, the loss of overall functionality in older individuals is valuable information for preventing individual risks, understanding the biopsychosocial phenomenon accompanying aging, and serving as a basis for clinical decision-making within an interdisciplinary treatment context (Sischo & Broder, 2011; Yoshimoto *et al.*, 2021; Wang *et al.*, 2022). Islas-Granillo *et al.* (2019), concluded that dental loss is higher in older individuals with multiple morbidities, and edentulism would be an indicator of health that could be included when evaluating multimorbidity in this age group.

The objective of this study is to present the geriatric conditions of individuals aged 70 and above, who wear deficient removable dental prostheses (RPDs), have lost their masticatory capacity, and are on the waiting list for oral rehabilitation. This research is part of the FONIS SA20I0052 Project, titled: "Evaluation of the impact on the overall functionality of the application of an immediate prosthetic functionalization protocol in patients with deficient removable prostheses, compared to conventional treatment provided at the secondary level of the healthcare system for individuals aged 70 and above." This is a randomized, controlled, single-blind clinical trial with a parallel group design.

MATERIAL AND METHOD

A descriptive, cross-sectional study was conducted on older individuals wearing deficient removable dental prostheses, who attended the dental prosthetic rehabilitation service of Hospital Del Salvador in Santiago, Chile, between the years 2021 and 2023.

Patients who accepted to participate in the FONIS SA20I0052 project by providing informed consent were included in the study. They were referred from Primary Health Care and recruited in Del Salvador Hospital. Therefore, all participants had FONASA coverage, the National Health Fund of the public health system of Chile. All participants were users of both maxillary and mandibular prostheses, aged 70 years and above, and classified according to the Eichner Index in groups B3, B4, C1, C2, and C3. Exclusion criteria included patients with severe cognitive impairment, neurodegenerative diseases affecting oral muscular movements, and individuals with soft tissue pathologies such as fibromas, fissured epulis, or hyperplasia that delayed the start of prosthetic treatment.

Demographic and clinical data, including age, sex, education level, support networks, habits, geriatric syndromes, and biomedical conditions, were recorded in the electronic clinical records. Additionally, for overall functionality evaluation, indicators of muscular conditions related to sarcopenia, such as handgrip strength, Timed Up and Go test, and calf circumference measurement, were measured and recorded. Nutritional status was assessed using the body mass index (BMI).

Handgrip strength, as a measure of muscle

strength, was assessed with the prostheses in occlusion using a hydraulic manual dynamometer (Jamar TM) for 2 to 3 seconds, and three measurements were taken, recording the highest value. According to the European Working Group on Sarcopenia in Older People, grip strength levels ≤ 30 kg in men and ≤ 20 kg in women indicate a risk of sarcopenia (Cruz-Jentoft *et al.*, 2010).

For fall risk assessment, the Timed Up and Go test, which is part of the EMPAM, was utilized. This involved using a chair, a stopwatch, and a mark on the floor located 3 meters away from the chair. The time taken by the patient to stand up from the chair, walk to the mark, turn around, and return to sit in the chair was measured. The patient used their usual support devices, such as a cane or walker. Fall risk classification was based on the time taken for the task, with scores categorized as follows: normal ≤ 10 sec, mild fall risk 11 to 20 sec, and high fall risk > 20 sec (Ministerio de Salud, 2008).

BMI used as a nutritional indicator, was calculated by dividing weight in kilograms by the square of height (BMI = Weight (kg) / Height (m²)). BMI values ≤ 23 were classified as weight deficit, 23.1 to 27.9 as normal, 28 to 31.9 as overweight, and > 32 as obese (Ministerio de Salud, 2008). Calf circumference measurement was also performed as a surrogate marker for muscle mass in sarcopenia diagnosis. Cut-off values for predicting low muscle mass were suggested as < 34 cm in men and < 33 cm in women (Kawakami *et al.*, 2015; López Lirola *et al.*, 2016).

Additionally, patients were classified according to the Eichner Index into subcategories B3, B4, and all subcategories C, and the type of prostheses they wore, was recorded.

Descriptive statistics, including frequency and means, were used for data analysis.

The research was approved by the Ethics and Scientific Committee of the Eastern Metropolitan Health Service of the Ministry of Health of Chile (FONIS SA20I0052 Project).

RESULTS

The sample consisted of 124 patients, with 41.1 % being men and 58.9 % women. The mean age for men was 82.4 years, and for women, it was 80.4 years.

About 48 % of the participants were between 70 and 80 years old, while 52 % were 81 years old and older. Regarding education level, 20.1 % had access to higher education, of which 4.8 % completed it partially. Additionally, 17.7 % had incomplete primary education, and 2.4 % had no formal education. Furthermore, 21.8 % completed their secondary education, while 25 % only completed it partially. In terms of household arrangements, 44.4 % lived with a partner, 22.6 % lived alone, and the rest lived with some family member. As for habits, 50.8 % reported alcohol consumption, and 5.6 % were tobacco consumers.

The most prevalent morbidities were hypertension (66.4 %), diabetes (32.7 %), dyslipidemia (17.8 %), hypothyroidism (12.1 %), renal insufficiency (3.7 %), and chronic obstructive pulmonary disease.

Regarding geriatric syndromes, 81.5 % had visual impairments, and 36.3 % had hearing impairments. The mean number of medications per person was 4.32, indicating polypharmacy. Additionally, 31.5 % of participants had experienced one or more falls in the last 6 months.

Table I shows the observed values for muscular conditions. For BMI, the lowest mean was found in the Eichner group B3 (24.04), and the highest was

in group C2 (27.77). All values fell within the normal range. The lowest mean calf circumference was observed in the 70 to 75 age group, with a mean of 34.5 cm, all of which were within the normal range.

The most consumed medications were Losartan, Atorvastatin, Metformin, Aspirin, Paracetamol, Omeprazole, Eutirox, and Amlodipine (all trademarks). Among 344 mentions of medications, antihypertensives represented 20.9 %, and analgesics accounted for 13.4 % (Fig. 1).

For masticatory functional conditions, measured using the Eichner Index, 75.8 % had lost all posterior support zones, represented by category C with its three subcategories. The distribution by categories and subcategories are shown in Figure 2.

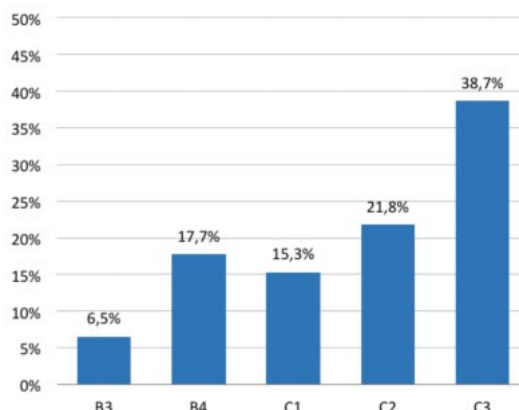


Fig. 2. Sample distribution according to Eichner Index.

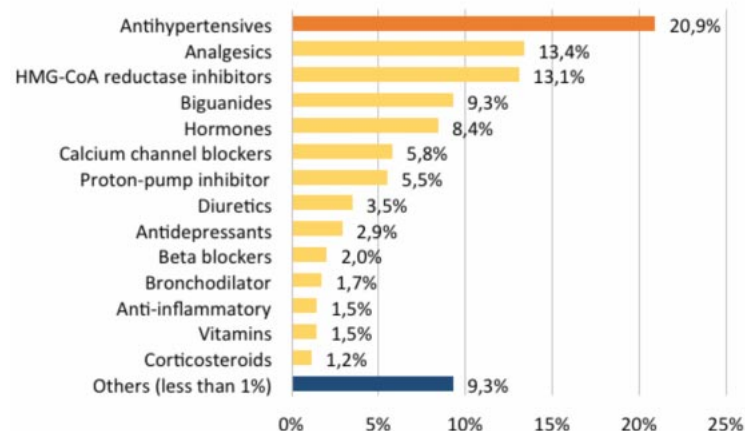


Fig. 1. Drugs most by the study sample.

Regarding the old prostheses that participants were wearing at the beginning of treatment, 53.2 % were acrylic total dentures for the upper arch, and 38.7 % were for the lower arch. Acrylic partial dentures accounted for 33.1 % of the upper arch and 41.1 % of the lower arch. Metallic framework partial dentures represented 12.9 % of the upper arch and 19.4 % of the lower arch. There was one case of Valplast (tm) RPDs for both the upper and lower arches, representing 0.8 % of the prostheses in each arch.

Table I. Geriatric characteristics of muscle conditions.

Characteristics	Men	Women	Total
Timed up and go	14.3 sec (± 6.6)	14.9 sec (± 6.5)	14.6 sec (± 6.5)
Mandible hand grip strength at rest	28.36 kg (± 6.6)	18.14 kg (± 4.7)	23.3 kg (± 7.5)
Force of manual grip mandible in occlusal contact	27.84 kg (± 6.3)	17.99 kg (± 4.5)	22.92 kg (± 6.9)
Body mass index	27.16 (± 3.4)	26.44 (± 3.8)	26.8 (± 3.7)
Calf circumference	35.5 cm (± 2.9)	35.2 cm (± 2.7)	35.4 cm (± 2.9)

DISCUSSION

This study investigated multiple important geriatric conditions and characteristics in older individuals who have lost oral functionality. There is limited evidence regarding older individuals receiving dental prosthetic treatments. The majority of the explored group were women (58.9 %), and 52 % were aged 81 years and older. This finding is significant concerning the increasing life expectancy observed in Chile in recent years. As the population ages, health care should be provided through interdisciplinary teams focused on maintaining functionality and considering the overall impact of different health disciplines involved. A study conducted at the Faculty of Dentistry of the Federal University of Rio Grande do Norte in Brazil (Alves *et al.*, 2018), which rehabilitated edentulous individuals with new complete dentures, reported a maximum age of 82 years.

Regarding education level, 15.3 % had completed higher education. Notably, 20.1 % had either no formal education (2.4 %) or incomplete primary education (less than 8 years), which is consistent with national data from the CASEN 2017 survey, reporting a mean of 7.5 years of schooling for 70 years and older age groups (Ministerio de Desarrollo Social, 2018).

Concerning geriatric syndromes, 81.5 % of the patients described visual impairments, and 36.3 % reported hearing impairments. Both conditions have the potential to impact the susceptibility to frailty in older patients, which is essential for dentists as part of an interdisciplinary team to detect. Varadaraj *et al.* (2019), concluded that older adults with visual impairment were more likely to be pre-frail or frail, suggesting an association between visual impairment and frailty. They also observed a trend that men with hearing loss were more likely to develop frailty compared to their peers with normal hearing, indicating a potential association between hearing loss and frailty.

Regarding the geriatric syndrome of falls, 31.5 % of the participants had experienced one or more falls in the last 6 months. This is similar to data provided by the Ministry of Health in their Falls Prevention Manual, estimating that one in three older adults' experiences one or more falls per year (López *et al.*, 2010). Additionally, the Health, Well-being, and Aging Survey (SABE) identified an annual prevalence of 35.3 % of falls in older adults.

The observed polypharmacy is consistent with

information reported in several countries for this age group, with percentages higher than 60 % using more than three medications (Salech *et al.*, 2016). During interdisciplinary care, it is crucial to detect polypharmacy and consider consulting a geriatrician to assess possible pharmacological interactions. A systematic review with meta-analysis by Gutiérrez-Valencia *et al.* (2018), has suggested that reducing polypharmacy could be a strategy to prevent and manage frailty.

It is worth mentioning that the entire sample required dental treatment due to defective prostheses, and their subcategories in the Eichner Index (B3, B4, C1, C2, and C3) indicated a loss of masticatory functionality (Nakatsuka *et al.*, 2010). Both conditions have been associated with a higher risk of falls, indicating that preventing tooth loss and providing dental prosthetic rehabilitation in older adults could prevent falls (Yamamoto *et al.*, 2012).

The timed up-and-go test showed very similar mean values in men and women, 14.3 seconds and 14.9 seconds, respectively, classifying these patients at low risk of falls (Ministerio de Salud, 2008). This is consistent with studies (Inui *et al.*, 2016) that concluded that a decrease in the number of teeth and occlusal support zones (molars and premolars) could be risk factors for slower walking speed in a timed 10-meter walk test.

Regarding handgrip strength, the mean in men, measured with the jaw in occlusal contact, was 27.84 kg, and in women, it was 17.99 kg. Both values indicate a risk of sarcopenia (Cruz-Jentoft *et al.*, 2010). This is supported by studies in older Korean populations (Hye-Sun Shin, 2019), which showed a significant association between the number of teeth and handgrip strength. They concluded that handgrip strength is a powerful marker of sarcopenia and frailty in older adults. Systematic reviews and prospective studies have demonstrated that handgrip strength predicts later physical health problems, cognitive decline, and all-cause mortality, emphasizing the importance of considering these parameters during comprehensive care for older adults.

Regarding BMI, the overall mean was 26.8. According to the Eichner Index, the lowest BMI mean was found in group B3, with a value of 24.04, and the highest was in group C2, with a value of 27.77. The

mean BMI falls within the normal range, close to values found in an older population in Rio de Janeiro, with a mean of 24.7 (Borba de Amorim *et al.*, 2008). On the other hand, the observed values slightly differ from a study in 140 older Peruvian individuals (Aquino *et al.*, 2019), where the overall mean BMI was 22.48, and the Ministry of Health of Peru established normal values in similar ranges to those of Chile.

For calf circumference, the mean in men was 35.5 cm, and in women, it was 35.2 cm. The lowest mean was observed in the 70 to 75 age group, with a mean of 34.5 cm. All values were within the normal range, indicating no risk of sarcopenia. This differs from a Japanese study that evaluated calf circumference (Ishii *et al.*, 2014) in older individuals, with 977 men and 994 women, where 14.2 % of men had a mean circumference of 32.8 cm, and 22.1 % of women had a mean circumference of 32.1 cm, both considered indicative of sarcopenia.

The most prevalent morbidities in this study were arterial hypertension (66.4 %), diabetes (32.7 %), dyslipidemia (17.8 %), hypothyroidism (12.1 %), renal insufficiency (3.7 %), and chronic obstructive pulmonary disease (3.7 %). According to the National Dependency Survey, 72.5 % of older adults report having at least one chronic disease, with the highest prevalence of hypertension (62.1 %), osteoarthritis (43.6 %), diabetes (21.8 %), and depression (18 %) (Servicio Nacional del Adulto Mayor, 2010). 23 % of the total global disease burden is attributed to disorders in individuals aged 60 years and older, with the major contributors to the burden being cardiovascular diseases (30.3 % of the total burden), malignant neoplasms (15.1 %), chronic respiratory diseases (9.5 %), musculoskeletal disorders (7.5 %), and neurological and mental disorders (6.6 %) (Prince *et al.*, 2015).

Visual and hearing impairments, polypharmacy, increased risk of falls, risk of sarcopenia, and higher rates of tooth loss are characteristics of older adults and are recognized as geriatric syndromes described by the World Health Organization (2022) as common conditions associated with aging. The health needs of this age group must be addressed from a multidimensional perspective for both diagnosis and treatment, in line with proposals made by Hopewell *et al.* (2018) and Briggs *et al.* (2022). This reinforces the importance of dentists evaluating and planning treatment within an interdisciplinary framework, as older adults present multiple characteristics that must be considered when planning a specific treatment (Böll *et al.*, 2022).

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RESUMEN: Envejecer es un proceso gradual y adaptativo que conlleva cambios, que reducen la capacidad funcional y fisiológica. Cada persona mayor presenta condiciones de salud heterogéneas que deben ser consideradas por el equipo interdisciplinario a cargo de su mantención funcional y estado de salud. Estudio descriptivo, corte transversal, en personas mayores portadoras de prótesis dentales removibles deficientes, del servicio dental de rehabilitación protésica del Hospital Del Salvador de Santiago de Chile, entre los años 2021-2023. Se emplearon instrumentos e índices para realizar registro y medición de condiciones musculares como fuerza de presión manual, prueba Timed Up and Go y medición del perímetro de pantorrilla. Se recolectó información asociada a nivel de escolaridad, síndromes geriátricos, enfermedades crónicas y cantidad de fármacos que consumen. Un 58,9 % eran mujeres, la edad media de hombres fue de 84,2 años y la de mujeres fue de 80,4 años. Un 20,8 % tuvo acceso a educación superior. El 22,6 % vive solo. Un 78,5 % ha perdido todas las zonas de soporte dentario posterior. Un 81,5 % tiene alteraciones visuales; un 36,3 % alteraciones auditivas; un 31,5 % ha tenido 1 o más caídas en los últimos 6 meses. La media de fármacos fue de 4,32 por persona. Las morbilidades más prevalentes fueron hipertensión arterial (66,4 %) y diabetes tipo II (32,7 %). Los valores promedio encontrados para hombres/mujeres en fuerza de presión manual fueron 27,84 Kg/17,99 kg, Timed Up and Go fueron 14,3 sec / 14,9 sec, IMC 27,16/ 26,44 y perímetro de pantorrilla 35,5 cm / 35,2 cm. Todos los datos clasificaron en el rango de normalidad. Las características observadas son importantes a considerar al momento de planificar tratamientos e implementar medidas orientadas a mantener funcionalidad oral y general. Éstas deben ser abordadas desde una mirada multidimensional, incluyendo los factores de riesgo, tanto en el diagnóstico como su tratamiento odontológico.

PALABRAS CLAVE: envejecimiento, fragilidad, adulto mayor, prótesis dentales.

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