

Evaluating edentulism and frailty in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres in Lambayeque, Peru.

Condiciones de edentulismo y fragilidad en un grupo de personas mayores que acudieron a la clínica odontológica de la Universidad San Martín de Porres de Lambayeque, Perú.

Rubén Chumpitaz-Durand.¹
Freddy Manayay-Llaguento.¹
Daniel Córdova-Sotomayor.²

Affiliations:

¹Universidad San Martín de Porres. Facultad de Odontología. Filial Norte, Chiclayo, Peru.

²Universidad Peruana Cayetano Heredia. Facultad de Estomatología. Lima, Peru.

Corresponding author: Carlos Neyra-Rivera. Universidad San Martín de Porres. Facultad de Odontología. Avenida la Pradera 19, Chiclayo 14012, Perú. **Phone:** (51) 996475051. **E-mail:** rubencd@hotmail.com

Receipt : 01/19/2020 **Revised:** 04/15/2021
Acceptance: 08/30/2021

Abstract: **Introduction:** Dentistry should contribute to achieving healthy aging based on the identification of the well-being and oral health needs of the elderly. **Objective:** To evaluate the conditions of edentulism and frailty in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres in Lambayeque, Peru, between the years 2016 and 2018. **Material and Methods:** An observational, descriptive, retrolective, and cross-sectional study was conducted. Two hundred and seven medical records that included an odontogram were randomly selected to identify cases of total or partial edentulism according to the Kennedy classification. The files were assessed with Fried's test to evaluate the conditions of frailty. The association between variables was estimated by means of a significance analysis using the Chi square test. **Results:** There was a statistically significant difference between edentulism in both jaws and conditions of frailty ($p<0.05$). An association of edentulism with physical inactivity and weakness was also demonstrated. Additionally, a statistically significant difference between degrees of edentulism was observed regarding poor diet ($p<0.05$). **Conclusion:** The absence of teeth in the elderly acts as a risk factor leading to negative changes in diet, weight, and physical activity. These changes may be associated with frailty, as masticatory insufficiency results in a poor diet and subsequent weakness.

Keywords: oral health; mouth, edentulous; tooth loss; frail elderly; healthy aging; Peru.

Cite as: Chumpitaz-Durand R, Manayay-Llaguento F & Córdova-Sotomayor D.

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J Oral Res 2021; 10(4):1-9

Doi:10.17126/joralres.2021.051

Resumen: **Introducción:** El aporte de la Odontología debe contribuir a lograr un envejecimiento saludable, basado en la identificación de las necesidades de bienestar y salud bucal de las personas mayores. **Objetivo:** Evaluar la condición de edentulismo y de fragilidad en un grupo de personas mayores atendidas en la Clínica Odontológica de la Universidad San Martín de Porres de Lambayeque, entre los años 2016 y 2018. **Material y Métodos:** Se diseñó un estudio observacional,

descriptivo, retrolectivo y transversal, seleccionando de manera aleatoria 207 historias clínicas que incluyeron un odontograma para identificar casos de edentulismo total o parcial de acuerdo a la clasificación de Kennedy: mientras que para evaluar las condiciones de fragilidad fueron revisadas las fichas con el test de Fried. Diferencias entre variables fueron evaluadas con un análisis de significancia mediante la prueba Chi cuadrado. **Resultado:** Se mostró una diferencia estadísticamente significativa entre edentulismo en ambos maxilares y condiciones de fragilidad ($p < 0,05$). Se evidenció además asociación de edentulismo con inactividad física

y debilidad; observándose adicionalmente una diferencia estadísticamente significativa entre grados de edentulismo en relación a la mala alimentación ($p < 0,05$). **Conclusion:** La ausencia de dientes en las personas mayores funge como un factor de riesgo que contribuye a cambios desfavorables en la dieta, el peso y la actividad física, mismos que se asocian con la fragilidad, donde la insuficiencia masticatoria puede conducir a una deficiente alimentación y la consecuente debilidad.

Palabra Clave: salud bucal; boca edéntula; pérdida de diente; anciano frágil, envejecimiento saludable; Peru.

INTRODUCTION.

In elderly people, frailty is a condition characterized by a progressive decrease in the physiological reserves of multiple body systems, which worsens as the person gets older.¹ This causes greater vulnerability to external conditions, which in turn leads to a greater probability of developing disorders that may affect old people's health, well-being, and quality of life.^{2,3}

In its gradual process, the deterioration of various functions and the decrease in their capacities are accompanied by adverse manifestations such as weakness, intolerance to effort, and development of functional dependence, which consequently compromise the physical, emotional, and social integrity of the elderly,^{4,5} especially when they live in an unfavorable socio-economic context.⁵

It is evident that complications caused by chronic degenerative diseases make old people extremely vulnerable and significantly increase their risk of mortality.^{6,7} For this reason and in order to avoid permanent damage, it is necessary to act promptly and implement preventive measures aimed at ensuring healthy aging.^{8,9}

In Peru, the projection for the year 2021 is 3,726,524 elderly people.¹⁰ In this context, 11.2% of the Peruvian population could be exposed to different degrees of frailty. As an additional element of this problematic reality, a progressive tooth loss has been observed with relative frequency as age increases, especially in the inhabitants of rural areas of the country.^{11,12} The severity of edentulism is evidenced in the physiological

alterations of the stomatognathic system, including the masticatory function, which eventually affects the nutritional status of these people,^{12,13} and their ability to speak, which hinders their communication and socialization. Additionally, it alters their aesthetic harmony, which leads to isolation and consequently to the development of emotional problems,^{11,13} aspects that could further worsen their frailty.

In this context, Eustaquio *et al.*,¹⁴ found an association between older age and tooth loss. Researchers such as Luengas *et al.*,¹⁵ and Ordaz *et al.*,¹⁶ found cases of edentulism as a consequence of systemic diseases such as diabetes. In other studies, authors such as Bellamy *et al.*,¹⁷ as well as Porto *et al.*,¹⁸ concluded that tooth loss is a predisposing factor for a low quality of life, mainly in elderly people.

The gradual loss of teeth as a stigma and a sign of health problems in older people deserves priority attention, considering that they could be exposed to conditions of vulnerability. Consequently, the significant prevalence of edentulism in older people in Lambayeque makes it possible to estimate a probable association with cases of frailty, since such conditions tend to be more prevalent in the elderly.

Precisely the purpose of this research, given the scarce data from similar studies, is producing new scientific evidence that may show the association between edentulism and frailty in older adults who attended the dental clinic at Universidad San Martín de Porres - North Branch, during the years 2016, 2017, and 2018.

MATERIALS AND METHODS.

An observational, descriptive, retrolective, and cross-sectional study was carried out with the aim of evaluating the possible association between the conditions of edentulism and frailty, based on the data collected from medical records that included an odontogram and a medical file to evaluate the condition of frailty. The population consisted of 447 medical records of elderly patients, treated at the dental clinic of Universidad San Martín de Porres, between March and November of 2016, 2017, and 2018. The sample was obtained based on the formula of population proportions, with a statistical confidence level of 95%. In this way, a sample of 207 medical records was obtained by means of a probabilistic method through a simple random process.

Regarding the selection criteria, the medical records of male and female patients over 59 years of age, who did not present illnesses or any serious disability that prevented their participation, were included in the study. They consisted of properly registered medical records with legible handwriting containing the data required to evaluate the study variables. The medical records of patients who at the time of their diagnostic evaluation did not give their informed consent or that of their direct relatives were excluded from the study.

The authorities of Universidad San Martín de Porres granted the permission and gave access to the files of medical records, which included the patients' odontograms. The latter are widely used instruments in multiple studies, such as in the cases of edentulism registered following the criteria of Edward Kennedy, cited by Huamanciza *et al.*,¹⁹ in which they considered the following classes:

Class I: with edentulous posterior areas bilaterally and remaining anterior teeth; Class II: a unilateral edentulous area, due to the absence of posterior teeth on that side, with no further teeth behind the edentulous area; Class III: A posterior partial edentulous area and the presence of teeth located both anteriorly and posteriorly to it; Class IV: anterior edentulous area on both sides of the midline.¹⁹

Regarding the form used to evaluate frailty, it was organized in two sections.

The first section identified the presence or absence of general frailty conditions, among them:

polypharmacy, hospitalization, disability, and poor diet. The absence of frailty was registered with zero and the presence with a score of one, so the minimum value was zero and the maximum value was four points for each patient. In the second section of the form, the criteria established by Linda Fried, applied by Jurschik *et al.*,²⁰ were followed to evaluate the conditions of frailty, based on: weakness, physical inactivity, weight loss, decreased walking speed or slowness, and self-reported chronic fatigue or exhaustion, so that each aspect that indicates an unfavorable criterion of frailty was assigned a point. This resulted in three categories: patient with absence of frailty with a value of "zero points," patient with pre-frailty with a value of "one to two points," and a frail patient with "three to more points."³

The validation of the data provided in the medical records and in the files to assess frailty conditions was carried out by previously applying them as pilot tests to a group of 30 elderly people from the "Señor de los Milagros" nursing home in Lambayeque, having obtained satisfactory levels of reliability.

Regarding the data analysis, the edentulous variable was operationalized in two categories: cases without edentulism and cases with partial or total edentulism. The conditions of frailty were also organized into two categories: cases without frailty and cases with pre-frailty or frailty.

The data were processed using the SPSS statistical software version 24, through which the frequencies of the study variables were obtained, applying the Chi square test. Statistical significance was assumed when $p < 0.05$. This study followed the bioethical principles established in the Declaration of Helsinki and was approved by the Bioethics Commission and the Research Area of Universidad San Martín de Porres under Rectoral Resolution No. 518-2017-CU-R-USMP.

RESULTS.

Table 1 shows that, of the general conditions of frailty and edentulism analyzed in the elderly population, there was a statistically significant difference between conditions of edentulism in the maxilla ($p < 0.05$) regarding poor nutrition.

Regarding the analysis carried out for the mandible, Table 2 also shows statistical significance regarding

Table 1. Frequency of general conditions of frailty and edentulism in the maxilla, in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres - North Branch. Data obtained from odontograms and records obtained using Fried's Test between the years 2016 and 2018.

General conditions of frailty		Edentulous conditions in the mandible Kennedy classification							p-value*
		Without edentulism	Class I	Class II	Class III	Class IV	Total edentulous	Total	
Polypharmacy	Absence	9	24	10	19	1	3	66	0.973
	Presence	15	47	26	44	2	7	141	
	Total	24	71	36	63	3	10	207	
Hospitalization	Absence	23	57	29	55	3	8	175	0.436
	Presence	1	14	7	8	0	2	32	
	Total	24	71	36	63	3	10	207	
Disability	Absence	18	40	23	34	2	4	121	0.382
	Presence	6	31	13	29	1	6	86	
	Total	24	71	36	63	3	10	207	
Poor nutrition	Absence	24	27	10	12	1	0	74	0.000
	Presence	0	44	26	51	2	10	133	
	Total	24	71	36	63	3	10	207	

*: Chi square test

Table 2. Frequency of general conditions of frailty and edentulism observed in the lower jaw, in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres - North Branch. Data obtained from odontograms and records obtained using Fried's Test between the years 2016 and 2018.

General conditions of frailty		Edentulous conditions in the mandible Kennedy classification							p-value*
		Without edentulism	Class I	Class II	Class III	Class IV	Total edentulous	Total	
Polypharmacy	Absence	9	24	10	19	1	3	66	0.973
	Presence	15	47	26	44	2	7	141	
	Total	24	71	36	63	3	10	207	
Hospitalization	Absence	23	57	29	55	3	8	175	0.436
	Presence	1	14	7	8	0	2	32	
	Total	24	71	36	63	3	10	207	
Disability	Absence	18	40	23	34	2	4	121	0.382
	Presence	6	31	13	29	1	6	86	
	Total	24	71	36	63	3	10	207	
Poor nutrition	Absence	24	27	10	12	1	0	74	0.000
	Presence	0	44	26	51	2	10	133	
	Total	24	71	36	63	3	10	207	

*: Chi square test

Table 3. Frequency of frailty conditions according to Fried's criteria and edentulous conditions observed in the maxilla, in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres - North Branch. Data obtained from odontograms and records obtained using Fried's Test between the years 2016 and 2018.

General conditions of frailty		Edentulous conditions in the mandible Kennedy classification							p-value*
		Without edentulism	Class I	Class II	Class III	Class IV	Total edentulous	Total	
Weight loss	Absence	18	32	17	37	4	6	114	0.157
	Presence	5	25	19	39	2	3	93	
	Total	23	57	36	76	6	9	207	
Exhaustion	Absence	12	25	14	43	4	0	98	0.022
	Presence	11	32	22	33	2	9	109	
	Total	23	57	36	76	6	9	207	
Physical inactivity	Absence	17	33	21	47	1	2	121	0.037
	Presence	6	24	15	29	5	7	86	
	Total	23	57	36	76	6	9	207	
Slowness	Absence	14	26	16	46	2	2	106	0.123
	Presence	9	31	20	30	4	7	101	
	Total	23	57	36	76	6	9	207	
Weakness	Absence	14	18	7	24	1	1	65	0.016
	Presence	9	39	29	52	5	8	142	
	Total	23	57	36	76	6	9	207	

*: Chi square test

Table 4. Frequency of frailty conditions according to Fried's criteria and edentulous conditions observed in the mandible, in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres - North Branch. Data obtained from odontograms and records obtained using Fried's Test between the years 2016 and 2018.

Conditions of frailty according to Fried*		Edentulous conditions in the mandible Kennedy classification							p-value*
		Without edentulism	Class I	Class II	Class III	Class IV	Total edentulous	Total	
Weight loss	Absence	18	42	21	28	1	4	114	0.115
	Presence	6	29	15	35	2	6	93	
	Total	24	71	36	63	3	10	207	
Exhaustion	Absence	14	31	16	32	2	3	98	0.604
	Presence	10	40	20	31	1	7	109	
	Total	24	71	36	63	3	10	207	
Physical inactivity	Absence	23	43	21	30	2	2	121	0.000
	Presence	1	28	15	33	1	8	86	
	Total	24	71	36	63	3	10	207	
Slowness	Absence	14	36	19	31	3	3	106	0.382
	Presence	10	35	17	32	0	7	101	
	Total	24	71	36	63	3	10	207	
Weakness	Absence	13	27	7	16	1	1	65	0.025
	Presence	11	44	29	47	2	9	142	
	Total	24	71	36	63	3	10	207	

*: Chi square test

Table 5. Frequency of the conditions of frailty and edentulism observed in the maxilla and mandible, in a group of elderly people treated at the dental clinic at Universidad San Martín de Porres - North Branch. Data obtained from odontograms and records obtained using Fried's Test between the years 2016 and 2018.

Conditions	Edentulous conditions in the mandible Kennedy classification						Total	Total	p-value*
	Without Edentulism	Class I	Class II	Class III	Class IV	Total edentulous			
Frailty									
No frailty	5	6	0	4	0	0	15		
Pre-Frailty	12	20	16	41	2	1	92		
Frailty	6	31	20	31	4	8	100		
Total	23	57	36	76	6	9	207		0.006
Mandible									
No frailty	4	7	1	3	0	0	15		
Pre-Frailty	18	32	13	25	2	2	92		
Frailty	2	32	22	35	1	8	100		
Total	24	71	36	63	3	10	207		0.004

*: Chi square test

Table 6. Frequency of frailty and edentulous conditions observed in the mandible, in a group of elderly people treated at the dental clinic of Universidad San Martín de Porres - North Branch. Data obtained from odontograms and records obtained using Fried's Test between the years 2016 and 2018.

Conditions of Frailty	Edentulism conditions according to Kennedy classification						Total	Total	p-value*
	Without Edentulism	Class I	Class II	Class III	Class IV	Total edentulous			
Maxilla									
No frailty	4	7	1	3	0	0	15		
Pre-Frailty	18	32	13	25	2	2	92		
Frailty	2	32	22	35	1	8	100		
Total	24	71	36	63	3	10	207		0.004

*: Chi square test

poor nutrition and degrees of tooth loss ($p < 0.05$), which did not happen with the other general conditions of frailty corresponding to polypharmacy, hospitalization, and disability.

The results in the previous tables show that tooth loss is probably related to poor chewing function, which may result in poor nutrition in the elderly. Regarding the results based on Fried's criteria to evaluate conditions of frailty, Table 3 shows that in the upper jaw, there is a statistically significant difference between the types of tooth loss regarding weakness, self-reported chronic fatigue or exhaustion, and physical inactivity, obtaining in the three cases a value of ($p < 0.05$). Likewise, the absence of an association between edentulism and weight loss was evidenced, as well as the non-existent association between tooth loss and slowness.

Regarding the lower jaw, Table 3 shows statistical significance between weakness and physical inactivity with respect to edentulous conditions. In the same way, a significant difference is observed between types of tooth loss regarding presence of weakness ($p < 0.05$). These results also indicate that no significant relationship could be found between tooth loss and exhaustion, weight loss, and slowness.

Results presented in Table 3 and Table 4 may show that the absence of teeth and poor nutrition could lead to conditions of weakness and physical inactivity.

Regarding the absence of teeth and types of frailty, Table 5 shows a significant difference between edentulous conditions in the upper and lower jaw in regards to frailty ($p < 0.05$). Consequently, older people have been considered patients in conditions of frailty or

pre-frailty. Regarding the conclusive results in Table 6, a greater statistical significance is observed between frailty and edentulous conditions but at the level of the lower jaw. Correlation studies between the two study variables should be proposed.

It should be noted as additional information that the most frequent classes of tooth loss correspond to Kennedy Class III and Class I, followed by Class II, while Class IV and cases of total edentulism were the ones that occurred less frequently, both in the upper and lower jaw. Regarding frailty conditions, a vast majority of cases consisted of frail and pre-frail elderly people, while non-frail patients represent the least number of cases.

DISCUSSION.

According to the Economic Commission for Latin America and the Caribbean (ECLAC),²¹ between the years 2015 and 2030 the world population aged 60 and over will rise from 900 to 1.4 billion, being the population group that will grow the most in that period. In Peru, experts from the National Institute of Statistics and Informatics – INEI,¹⁰ have estimated a projection towards the year 2021 of 3,726,534 older adults, corresponding to 11.2% of the Peruvian population. Faced with this tendency, studies carried out by Moles *et al.*,³ and by Riquelme *et al.*,²² indicate that the vulnerability to which the elderly are exposed predisposes them to conditions of frailty, presenting a greater risk of adverse events to their health.

Based on the problems that come with aging, the ECLAC²¹ specialists consider seeking the best conditions for a decent quality of life in older adults within a framework of human rights as a priority in the 2030 agenda for sustainable development. On their part, for the group of experts of the World Health Organization – WHO,²³ promoting healthy aging means generating favorable conditions for a sustainable quality of life, facilitating environments adapted to their older age, developing social insertion policies, and anticipating risks that may affect their well-being and health.

According to the articles published by Castro⁹ and Varela,²⁴ a preventive approach from a multidisciplinary methodology is necessary along with the active participation of different specialists to ensure healthy

aging. In relation to dentistry as one of the areas or specialties that are linked to the general health status of the elderly, Ordaz *et al.*,¹⁶ recognize that the elderly represent a group of special interest due to the vulnerability of their oral health. Additionally, the chronic diseases that affect them limit their tolerance to oral procedures and interventions.

In this regard, Azañedo *et al.*,²⁵ point out the importance of strengthening research in the field of oral health of the elderly, to promote the creation of public policies that not only may improve their oral health but also their well-being and quality of life. With this orientation, some researchers such as León *et al.*,²⁶ have reported that factors such as caries, periodontal disease, tooth loss, non-functional dental prostheses, lesions in the oral mucosa, and xerostomia, can have an unfavorable impact on quality of life in old age.

In addition, they have shown an association between oral health and systemic diseases such as diabetes mellitus, cardiovascular and respiratory diseases, due to common risk factors in the elderly population. In this sense, Porto *et al.*,¹⁸ as well as Padilla *et al.*,²⁷ also confirm the impact that oral health has on general health, so that some oral conditions and functional limitations in chewing, communication, and aesthetics, can cause some psychosocial alterations such as depression, anxiety, and isolation, which may negatively influence the living conditions of older adults.

Regarding the results of the present study, a statistically significant difference was found between the types of edentulism regarding the presence of frailty, in which tooth loss can consequently lead to poor nutrition, due to insufficient masticatory function. There was also observed a link between edentulism and physical inactivity and weakness, caused by factors inherent to aging and especially by poor nutrition. Although it is true that it was not possible to find many directly related studies, authors such as León *et al.*,²⁶ concluded that tooth loss, in addition to reducing the ability to speak, smile and socialize, decreases chewing capacity, leading to the consumption of a soft diet of low nutritional value, which in turn represents a risk factor for the aging process. In this regard, authors such as Almirón *et al.*,²⁸ when reporting a high prevalence of partial and total edentulism, agree on suggesting that the deterioration in oral functions brings about

additional limitations for patients exposed to frailty. In another study conducted by Osterberg *et al.*,²⁹ it is concluded that tooth loss can increase morbidity and even mortality in frail older people.

It should be noted, as reported by Bellamy and Moreno,¹⁷ as well as Azañedo *et al.*,²⁵ that in the absence of teeth, rehabilitation through partial or total prostheses have become an additional concern, because many times their deficient adaptability and precision, far from contributing to complementing oral functions, cause alterations that affect the patients' well-being and health, and consequently worsen their conditions of frailty. In this sense, León *et al.*,²⁶ argue that a poorly adjusted or defective prosthesis can be the cause of some oral alterations, but that also some chronic diseases in the elderly can reduce their neuromuscular capacity to adapt to prosthetic rehabilitation treatments.

As indicated by the studies carried out by León *et al.*,²⁶ and by Cepero *et al.*,³⁰ the training of professionals with experience and skills for the oral health care of the geriatric population should be based on a high-impact preventive and restorative approach that can meet the complex needs of older people.

As a contribution of the present study, the characterization of the elderly as fragile or non-fragile, added to their edentulous conditions according to the Kennedy classification, will allow the creation of a database that will be of utmost importance to address the oral health needs of the elderly. It will undoubtedly help to support a culture for healthy aging.

Consideration of the guidelines described in the STROBE statement, in addition to criteria that contributed to guaranteeing consistency in the control of possible biases, made it possible to rule out other factors that could have affected this research.

CONCLUSION.

Statistically significant results were evidenced between the cases of edentulism and the presence of frailty, both at the level of the upper and lower jaw, establishing a significant relationship between loss of teeth and poor nutrition, due to insufficient masticatory function.

Consequently, it was also observed that edentulism was associated with physical inactivity and weakness in the older adults who were part of the present study.

Therefore, simultaneous exposure to edentulous and frailty conditions predisposes older people to conditions of vulnerability that would continue to worsen if preventive measures aimed at healthy aging are not implemented. This calls for further studies in this regard.

Conflict of interests: The authors declare no conflict of interest of any kind.

Ethics approval: Study was approved by the Bioethics Commission and the Research Area of Universidad San Martín de Porres under Rectoral Resolution No. 518-2017-CU-R-USMP.

Funding: This study was self-financed.

Authors' contributions: All authors contributed equally to the entire investigation.

Acknowledgements: The authors would like to thank Red Peruana de Prevención Integral en Salud – EDUSALUD, for their technical support.

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