ORIGINAL ARTICLE

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

Mariana Silva Teixeira Cavalcanti[1], Fernanda Suely Barros Dantas[2]
Luis Henrique Guedes de Andrade Lima[3], Katarina Haluli Janô da Veiga Pessôa[4]
Mariana de Moraes Corrêa Perez[5], Alessandra de Albuquerque Tavares Carvalho[6]
Jair Carneiro Leão[7]

Highlights: (1) Hyposalivation was more prevalent in chronic kidney disease patients on hemodialysis. (2) Xerostomia was associated with older age in the hemodialysis group. (3) No association was found between xerostomia, hyposalivation, and the DMFT index.

PRE-PROOF

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[1] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0000-0002-9319-9738

[2] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0000-0002-1356-1275

[3] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0009-0000-2383-2991

[4] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0000-0002-0722-2568

[5] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0000-0001-6531-1684

[6] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0000-0003-0390-3611

[7] Universidade Federal de Pernambuco – UFPE. Recife/PE, Brazil. https://orcid.org/0000-0001-6576-2055

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

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ABSTRACT

Chronic kidney disease (CKD) is a serious condition with an increasing number of cases and a significant impact on oral and systemic health, with xerostomia being the most prevalent oral alteration. This study aimed to analyze xerostomia and hyposalivation in two groups (Hemodialysis and Healthy) and to relate these parameters to the decayed, missing, and filled teeth index (DMFT). This is an observational study involving 80 patients. The treatment group was referred from two hemodialysis centers in Recife, while the Healthy group had no CKD and was recruited from the Stomatology Clinic of the Federal University of Pernambuco (UFPE). DMFT index, salivary flow, and xerostomia data were recorded. In the Hemodialysis group, 15% of the patients presented hyposalivation, with a statistically significant difference compared to the Healthy group ($p = 0.038$). Xerostomia was reported by 20% of patients in the Hemodialysis group and 10% in the Healthy group, and the presence of caries occurred in 62.5% of the Hemodialysis group, with no statistically significant differences between groups. In this study, hyposalivation was more prevalent in patients with chronic kidney disease. However, it was not possible to relate hyposalivation and xerostomia to the DMFT index. Attention should be given to these patients so that medical treatments can be carried out without impediments due to dental causes.

Keywords: Xerostomia; Dental Caries; Renal Dialysis; Chronic Renal Insufficiency.

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INTRODUCTION

Chronic kidney disease (CKD) is defined as kidney damage lasting three months or longer, associated with structural or functional abnormalities of the kidney, with or without a reduction in glomerular filtration rate[1]. CKD represents a major global public health problem, with high prevalence, and has drawn the attention of the international scientific community. A high prevalence rate of CKD has been reported among adults aged 18 to 59 years[2]. There are several treatment options for CKD, such as oral medications, including antihypertensive drugs. Other treatment modalities include dialysis (hemodialysis and peritoneal dialysis) and/or kidney transplantation. However, these treatments are costly, have several side effects, and require long-term administration[3].

Oral diseases are present in approximately 90% of patients with CKD. Tissues and systems may be affected both by CKD itself and by its treatment and medications, which often directly or indirectly alter salivary flow, composition, and concentration, as well as other oral structures[4].

In the group of patients with renal disease undergoing hemodialysis, a worsening of oral conditions is expected, with an increase in xerostomia (a sensation of dry mouth caused by reduced or absent saliva production) and hyposalivation (decreased salivary output). These conditions may result in an increase in the decayed, missing, and filled teeth index (DMFT) due to the treatment itself, fluid intake restriction, and neglect of oral health by these patients in the face of the demands of chronic kidney disease care. However, there is still controversy in the literature regarding the relationship between chronic kidney disease and the caries index, with studies reporting an increase, a reduction, or even no statistically significant difference [4-6].

Therefore, the study and understanding of these oral diseases, which are the most prevalent in this population, may contribute to the implementation of effective measures aimed at improving quality of life and prognosis, since poor oral health and hygiene conditions are often aggravating factors in systemic health.

METHODS

Study participants: This was an epidemiological and observational study conducted with a convenience sample of individuals aged 18 years or older who agreed to participate, of both sexes, and allocated into two groups. The Hemodialysis Group consisted of 40 individuals with stage 5 chronic kidney disease undergoing hemodialysis, recruited from the Hemodialysis Centers of Maria Lucinda Hospital and the Hospital das Clínicas of the Federal University of Pernambuco (UFPE). The Healthy Group comprised 40 individuals without CKD, recruited from the University Stomatology Service. All participants were evaluated at the Stomatology Service of UFPE.

Data collection and clinical examination: All data were collected after obtaining written informed consent. Participants completed a structured questionnaire to obtain dental and medical data, as well as information regarding the history of the current disease. In addition, patients were asked about the sensation of dry mouth, and unstimulated salivary flow was measured over a 5-minute period. During collection, participants were instructed to sit in an upright position and remain relaxed. Salivary flow was calculated in milliliters per minute.

The clinical examination of both groups was performed at the Stomatology Service of UFPE, using a dental chair and a clinical mirror, with the aid of personal protective equipment (lab coat, mask, gloves, and cap). Examinations were conducted by a single examiner, and data were recorded by a calibrated recorder. For each patient, the number of decayed, missing, and filled teeth was recorded in order to calculate the DMFT index.

Eligibility criteria: Inclusion criteria for the Hemodialysis Group were individuals of both sexes, aged 18 years or older, undergoing hemodialysis treatment. Participation consent was obtained through signing the informed consent form. For the Healthy Group, individuals of both sexes aged 18 years or older who had never undergone hemodialysis or organ transplantation were included, with participation consent also obtained through signing the informed consent form.

Exclusion criteria for the Hemodialysis Group included individuals with fewer than eight teeth, positive HIV serology, less than three months of hemodialysis treatment, alcohol or

tobacco use, pregnancy, or lactation. For the Healthy Group, exclusion criteria included individuals with fewer than eight teeth, positive HIV serology, presence of any autoimmune disorder, alcohol or tobacco use, pregnancy or lactation, or use of immunosuppressive or anticoagulant drugs.

Statistical analysis: Data were expressed as mean (± standard deviation), minimum, and maximum values. Associations between descriptive measures were assessed using the nonparametric Mann–Whitney test for comparisons between two groups, as the data did not follow a normal distribution. For categorical data, Pearson's chi-square test and the likelihood ratio test were applied to verify possible associations or statistically significant differences. The level of significance was set at 5% ($p < 0.05$). Statistical analyses were performed using SPSS version 20.0, and data were entered into Microsoft Excel.

RESULTS

Eighty patients participated in this study and were divided into the Hemodialysis Group and the Healthy Group, each consisting of 40 individuals (Figure 1). The mean age of the participants was 45.94 years, with a standard deviation of 10.72 years. In the Healthy Group, 97.5% of participants were aged 31 years or older, while in the Hemodialysis Group, 85% were within this age range. Among all participants, 53.8% were female, 67.5% had never smoked, 53.8% did not use medications, and 62.6% had completed up to elementary education.

Smoking habits ($p = 0.004$) and medication use ($p < 0.001$) showed statistically significant differences between the Healthy and Hemodialysis groups. In the Healthy Group, 82.5% had never smoked, compared with 52.5% in the Hemodialysis Group. Additionally, 17.5% of individuals in the Healthy Group used medications, whereas 75.0% of those in the Hemodialysis Group reported medication use.

Regarding systemic diseases, a statistically significant difference was observed between the groups ($p < 0.001$). In the Hemodialysis Group, 72.5% of patients had systemic diseases, compared with only 22.5% in the Healthy Group (Table 1). The most frequently observed systemic disease in both groups was hypertension.

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

Variable		Group				Total		P-value
		Healthy		Hemodialysis				
		n	%	n	%	n	%	
Systemic disease	Yes	9	22,5	29	72,5	38	47,5	<0,001[1]*
	No	31	77,5	11	27,5	42	52,5	
Salivary flow	Hyposalivation	1	2,5	6	15,0	7	8,8	0,038[2] *
	Normal	39	97,5	34	85,0	73	91,3	
Xerostomia	Yes	4	10,0	8	20,0	12	15,0	0,210[2]
	No	36	90,0	32	80,0	68	85,0	
DMFT index	Yes	32	80,0	25	62,5	57	71,3	0,084[1]
	No	8	20,0	15	37,5	23	28,8	
	Total	**40**	**100,0**	**40**	**100,0**	**80**	**100,0**	

Table 1 – Absolute and relative frequency of the studied groups according to the variables Salivary Flow, Xerostomia, Presence of Caries, and Systemic Disease. Recife, PE, 2022.

[1] Pearson's chi-square test; [2] Likelihood ratio test; *Statistically significant.

Note: DMFT = Decayed, Missing, and Filled Teeth.

Source: The authors (2022).

In this study, hyposalivation showed a statistically significant difference between the groups (p = 0.038), occurring in 15% of the Hemodialysis Group. Xerostomia was present in 20% of this group and did not show a statistically significant difference between groups. The DMFT index was high, at 71.3%, with 80% in the Healthy Group and 62.5% in the Hemodialysis Group, but with no statistically significant difference between groups. The mean

DMFT in the Healthy Group was 12.50 ±4.68, ranging from 2 to 19, while in the Hemodialysis Group the mean DMFT was 12.60 ±4.68, also ranging from 2 to 19.

There was no statistically significant difference between DMFT and salivary flow in either the Healthy Group or the Hemodialysis Group, nor were there differences between the groups (Table 2). However, salivary flow showed statistically significant differences in relation to the smoking habit variable (p = 0.049) in the Hemodialysis Group; for this variable, only non-smokers and former smokers were evaluated. In this group, 83.3% of patients with hyposalivation were former smokers (Table 3). Variables such as medication use and systemic disease did not show statistically significant differences.

Group	**Variable / Salivary Flow**		**N**	**Mean**	**Standard Deviation**	**Minimum**	**Maximum**	**p-value[1]**
Healthy	DMFT	Hyposalivation	1	9,00	-	9,00	9,00	0,456
		Normal	39	12,59	4,71	2,00	19,00	
		Total	40	12,50	4,68	2,00	19,00	
	Age	Hyposalivation	1	47,00	-	47,00	47,00	0,930
		Normal	39	46,23	8,64	28,00	65,00	
		Total	40	46,25	8,53	28,00	65,00	
Hemodialysis	DMFT	Hyposalivation	6	10,17	3,13	7,00	14,00	0,170
		Normal	34	13,03	4,81	2,00	19,00	
		Total	40	12,60	4,68	2,00	19,00	

	Age	Hyposalivation	6	53,67	12,44	42,00	72,00	0,091
		Normal	34	44,21	12,31	23,00	62,00	
		Total	40	45,63	12,64	23,00	72,00	
	Treatment duration	Hyposalivation	6	72,50	54,40	7,00	144,00	0,090
		Normal	34	39,15	41,32	6,00	204,00	
		Total	40	44,15	44,38	6,00	204,00	

Table 2 – Descriptive measures of total DMFT values and age according to the Healthy and Hemodialysis groups. Recife, PE, 2022.

[1] Mann–Whitney nonparametric test; *Statistically significant.

Note: DMFT = Decayed, Missing, and Filled Teeth.

Source: The authors (2022).

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

ariable / Group			Salivary Flow				Total		p-value[1]
			Hyposalivation		Normal				
			n	%	n	%	n	%	
Sex	Healthy	Male	0	0,0	18	46,2	18	45,0	0,270
		Female	1	100,0	21	53,8	22	55,0	
		Total	1	100,0	39	100,0	40	100,0	
	Hemodialysis	Male	2	33,3	17	50,0	19	47,5	0,446
		Female	4	66,7	17	50,0	21	52,5	
		Total	6	100,0	34	100,0	40	100,0	
Fumo	Healthy	Never smoked	1	100,0	32	82,1	33	82,5	0,532
		Former smoker	0	0,0	7	17,9	7	17,5	
		Total	1	100,0	39	100,0	40	100,0	
	Hemodiálise	Never smoked	1	16,7	20	58,8	21	52,5	0,049 *
		Former smoker	5	83,3	14	41,2	19	47,5	
		Total	6	100,0	34	100,0	40	100,0	

Table 3 – Absolute and relative frequency of salivary flow according to sex and smoking status in each studied group (Healthy and Hemodialysis). Recife, PE, 2022.

[1] Likelihood ratio test; *Statistically significant.

Source: The authors (2022).

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

A relationship was found between age and xerostomia, with 41.2% of individuals aged over 51 years presenting xerostomia (p = 0.009) in the Hemodialysis Group. Age was not associated with the number of caries or with salivary flow (Table 4).

Variable / Group		Age Group						Total		p-value[1]
		20-30 years		31-50 years		Over 51 years				
		n	%	n	%	n	%	n	%	
Salivary Flow	**Healthy**									0,722
	Positive	0	0,0	1	3,4	0	0,0	1	2,5	
	Negative	1	100,0	28	96,6	10	100,0	39	97,5	
	Hemodialysis									0,345
	Positive	0	0,0	3	17,6	3	17,6	6	15,0	
	Negative	6	100,0	14	82,4	14	82,4	34	85,0	
Xerostomia	**Healthy**									0,486
	Yes	0	0,0	2	6,9	2	20,0	4	10,0	
	No	1	100,0	27	93,1	8	80,0	36	90,0	
	Hemodialysis									0,009*
	Yes	0	0,0	1	5,9	7	41,2	8	20,0	
	No	6	100,0	16	94,1	10	58,8	32	80,0	

Presence of Caries	**Healthy**									0,797
	Yes	1	100,0	23	79,3	8	80,0	32	80,0	
	No	0	0,0	6	20,7	2	20,0	8	20,0	
	Hemodialysis									0,554
	Yes	4	66,7	12	70,6	9	52,9	25	62,5	
	No	2	33,3	5	29,4	8	47,1	15	37,5	

Table 4 – Absolute and relative frequency of age groups according to the variables salivary flow, xerostomia, and caries in each studied group (Healthy and Hemodialysis). Recife, PE, 2022.

[1] Likelihood ratio test; *Statistically significant.

Source: The authors (2022).

Among patients undergoing hemodialysis, 70% had been receiving this treatment for five years or less, whereas 30% had been on hemodialysis for more than five years. Hemodialysis duration showed a statistically significant difference only in relation to hyposalivation, with 33.3% of patients who had been undergoing hemodialysis for more than five years also presenting hyposalivation ($p = 0.042$) (Table 5).

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

Variable	Hemodialysis Duration				Total		p-value[1]
	Up to 5 years		More than 5 years				
	n	%	n	%	n	%	
Salivary Flow							0,042*
Positive	2	7,1	4	33,3	6	15,0	
Negative	26	92,9	8	66,7	34	85,0	
Xerostomia							0,727
Yes	6	21,4	2	16,7	8	20,0	
No	22	78,6	10	83,3	32	80,0	
Presence of Caries							0,289
Yes	19	67,9	6	50,0	25	62,5	
No	9	32,1	6	50,0	15	37,5	
Total	**28**	**100,0**	**12**	**100,0**	**40**	**100,0**	

Table 5 – Absolute and relative frequency of hemodialysis duration according to the variables salivary flow, xerostomia, and caries. Recife, PE, 2022.

[1] Likelihood ratio test; *Statistically significant.

Source: The authors (2022).

It can be observed that only the Healthy Group showed a statistically significant association between medication use ($p = 0.006$) and systemic disease ($p < 0.001$) with xerostomia. In this group, 75.0% of individuals with xerostomia reported medication use, and 100% of those with xerostomia had at least one systemic disease (Table 6).

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

Variable / Group			Xerostomia				Total		p-value[1]
			Yes		No				
			n	%	n	%	n	%	
Medication Use	Healthy	Yes	3	75,0	4	11,1	7	17,5	0,006 *
		No	1	25,0	32	88,9	33	82,5	
		Total	4	100,0	36	100,0	40	100,0	
	Hemodialysis	Yes	6	75,0	24	75,0	30	75,0	1,000
		No	2	25,0	8	25,0	10	25,0	
		Total	8	100,0	32	100,0	40	100,0	
Systemic Disease	Healthy	Yes	4	100,0	5	13,9	9	22,5	<0,001 *
		No	0	0,0	31	86,1	31	77,5	
		Total	4	100,0	36	100,0	40	100,0	
	Hemodialysis	Yes	5	62,5	24	75,0	29	72,5	0,489
		No	3	37,5	8	25,0	11	27,5	
		Total	8	100,0	32	100,0	40	100,0	

Table 6 – Absolute and relative frequency of xerostomia according to medication use and systemic disease in each studied group (Healthy and Hemodialysis). Recife, PE, 2022.

[1] Likelihood ratio test; *Statistically significant.

Source: The authors (2022).

DISCUSSION

The present study found a statistically significant relationship between xerostomia and age in the Hemodialysis Group. Xerostomia is common in the elderly population and may also have several other causes, such as reduced fluid intake, increased uremic levels in the salivary glands, salivary gland hypofunction, medication use, smoking, Sjögren′s syndrome, among others [7-10].

Patients with chronic kidney disease undergoing hemodialysis tend to use multiple medications. This is because CKD is associated with several systemic diseases, such as diabetes and hypertension. Furthermore, CKD and hemodialysis treatment have a negative impact on an individual′s life, which may lead to depression and/or anxiety. Many patients also use diuretic medications during the interdialytic period in order to control hypertension, which tends to occur during this phase, as well as to reduce the incidence of cardiovascular mortality[11]. In agreement with the literature, this study found that medication use showed a statistically significant difference between the groups, being higher in the Hemodialysis Group. In addition, we found an association between xerostomia and duration of hemodialysis treatment, with patients undergoing hemodialysis for longer periods tending to present more hyposalivation, consistent with previous reports[12].

Li et al. (2018)[13] stated that greater exposure to smoking increases the likelihood of hospitalization and death due to chronic renal failure in patients undergoing hemodialysis, especially among younger and diabetic patients, with former smokers being the second highest-risk group, surpassed only by those who continue to smoke a large number of cigarettes per day. This finding corroborates our results, as nearly half of the hemodialysis patient population consisted of smokers or former smokers, and an association between smoking and hyposalivation was observed.

Considering these factors, a possible justification was found for the statistically significant difference in hyposalivation between the Healthy and Hemodialysis groups. Although the percentage of hyposalivation was low, it was significantly higher in the Hemodialysis Group, corroborating the findings of Cardoso et al. (2020)[12], who observed a

statistically significant difference between case and control groups; however, most participants exhibited normal salivary flow.

Kumar et al. (2020)[8] conducted a systematic review evaluating xerostomia reported by several studies. The percentages found were high, with the study showing the lowest prevalence being that of Cunha et al. (2017)[14], in which 40% of chronic kidney disease patients undergoing hemodialysis presented xerostomia, differing from the present study, which showed a much lower value.

Xerostomia did not differ between the groups but was associated with systemic diseases and medication use among participants in the Healthy Group, which in this study were mainly hypertension and antihypertensive medications. Kumar et al. (2020)[8] reported that it was not possible to determine whether the observed association was between xerostomia and hypertension itself or with its treatment. However, the number of medications used was not associated; rather, the type of drug was relevant, with alpha-adrenergic blockers and benzodiazepines being the most frequently associated.

Regarding the caries index in patients with chronic kidney disease, there is still controversy in the literature. Some studies suggest an increase in DMFT in these individuals, while others report a reduction. According to several studies, the number of decayed and restored teeth is significantly higher in patients with CKD undergoing hemodialysis than in healthy individuals. This may be explained, according to the authors, by reduced salivary flow and poor adherence to oral preventive care, since these patients frequently need to attend hospital settings for treatment, and it is also common that dentists are not adequately trained to manage these patients, leading to insecurity for both professionals and patients[6, 15-17].

Conversely, studies that found lower DMFT indices in the hemodialysis group justified their findings by the high concentration of urea in saliva, which may confer a certain protective effect against caries[18,19].

However, the results of the present investigation are consistent with those reported by Nascimento et al. (2018)[20], Andaloro et al. (2018)[21], Laheij et al. (2021)[4], and Menezes et al. (2019)[5], as no difference was observed between the DMFT index of the Healthy Group and the

Hemodialysis Group. Both groups presented high DMFT values, according to SB Brasil 2010[22], which reported the highest DMFT index in the elderly population aged 65–74 years, with a value of 27.53%. As a possible explanation for the high percentage found in our study, the DMFT of the Healthy Group may have been elevated due to a large number of filled teeth, that is, teeth that had received treatment. It is not possible to state that the buffering effect of salivary urea compensates for poor oral hygiene in individuals undergoing hemodialysis, as this was not the objective of the present study.

It is widely recognized that saliva plays an important role in maintaining and functioning oral tissues, ensuring oral homeostasis by modulating the oral ecosystem. Any condition that alters salivary production or composition may have negative consequences for oral and general health, as well as for patient well-being. In this context, hyposalivation leads to an increase in the number of caries and oral infections, elevated oral pH, and increased bacterial plaque deposition[8,23,24]. However, contrary to expectations, in the present study no statistically significant association was found between hyposalivation or xerostomia and the DMFT index. This may be due to the low prevalence of xerostomia and hyposalivation observed, which did not allow an association with the high DMFT values.

Hyposalivation and xerostomia are conditions with the potential to aggravate several oral diseases, and in this study, hyposalivation was more prevalent in patients with chronic kidney disease. Nevertheless, it was not possible to associate hyposalivation and xerostomia with the DMFT index.

Therefore, dentists must be prepared to provide care for individuals with CKD, ensuring that patients undergoing hemodialysis receive appropriate treatment and guidance regarding oral health, as well as oral environment management, so that medical treatments can be carried out without impediments due to dental causes. It is important to emphasize that these individuals may eventually undergo kidney transplantation and therefore require the elimination of any infectious focus prior to transplantation.

RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

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Author Contributions	
Mariana Silva Teixeira Cavalcanti:	Conceptualization / Data curation / Formal analysis / Project administration / Writing – original draft / Investigation
Fernanda Suely Barros Dantas:	Writing – review & editing
Luis Henrique Guedes de Andrade Lima:	Writing – review & editing / Formal analysis / Data curation / Visualization
Katarina Haluli Janô da Veiga Pessôa:	Writing – review & editing
Mariana de Moraes Corrêa Perez:	Investigation
Alessandra de Albuquerque Tavares Carvalho:	Supervision / Project administration/ Methodology
Jair Carneiro Leão:	Supervision
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RELATIONSHIP BETWEEN THE DECAYED, MISSING, AND FILLED TEETH INDEX (DMFT) AND THE PRESENCE OF XEROSTOMIA AND HYPOSALIVATION IN CHRONIC KIDNEY DISEASE PATIENTS ON HEMODIALYSIS

Corresponding Author:	Luis Henrique Guedes de Andrade Lima Universidade Federal de Pernambuco – UFPE Av. Prof. Moraes Rego, 1235 - Cidade Universitária Recife - PE, Brazil – Zip code 50670-901 luishenriqueguedes@hotmail.com

Editor-in-Chief:	Adriane Cristina Bernat Kolankiewicz. PhD
Editor:	Eliane Roseli Winkelmann. PhD

APPENDIX A – FIGURES

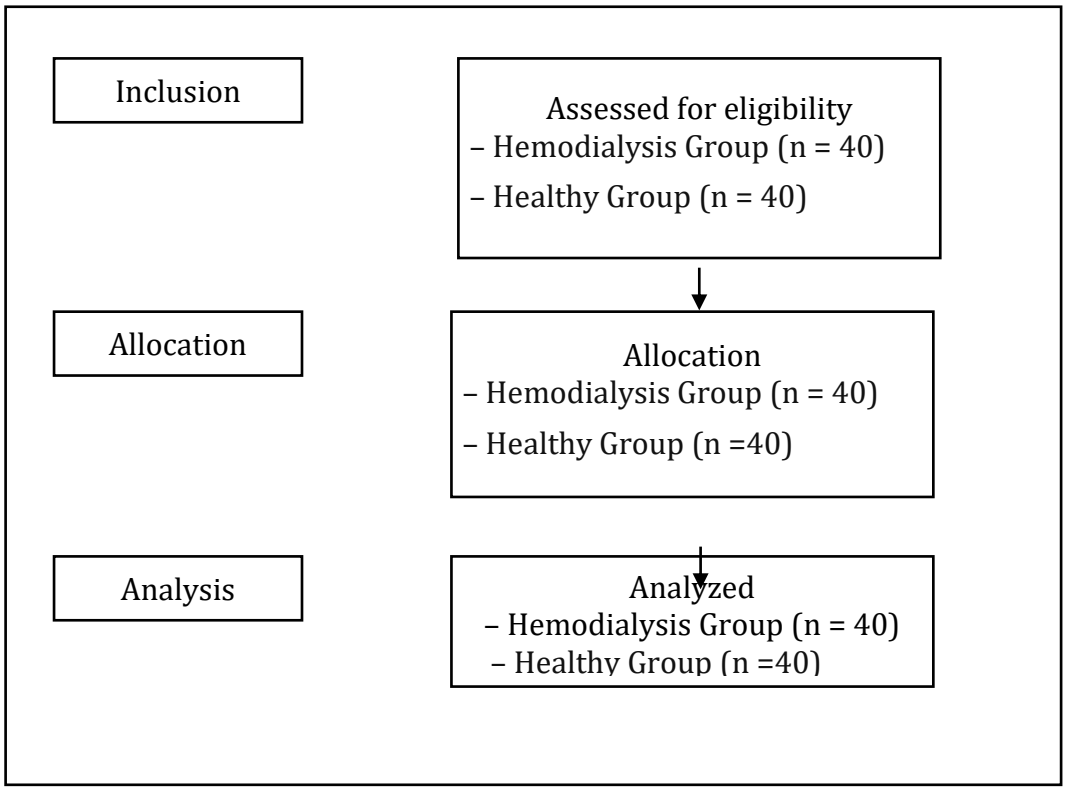


Figure 1 – Flowchart of study participants.

Source: The authors (2022).

APPENDIX B – CLINICAL RECORD

UNIVERSIDADE FEDERAL DE PERNAMBUCO
CENTRO DE CIÊNCIAS DA SAÚDE
PROGRAMA DE PÓS-GRADUAÇÃO

FICHA CLÍNICA

Relação entre o Índice CPO-D e à presença de xerostomia e hipossalivação em pacientes renais crônicos em hemodiálise

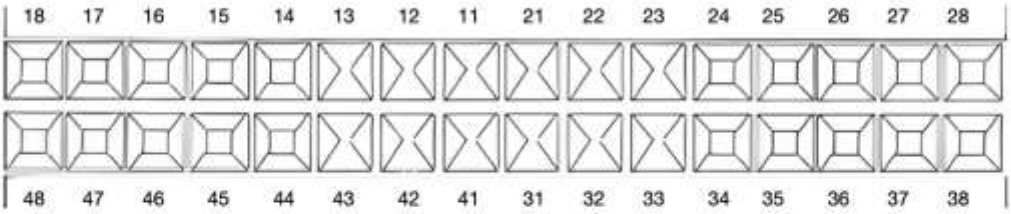
Grupo:( )Saudável ( )Hemodiálise

1. Nome:_____
2. Nacionalidade:_____
3. Sexo:_____
4. Idade:_____
5. Estado civil:_____
6. Fone: _____ Celular:_____
7. Hábito de fumar:

   ( ) nunca fumou
   ( ) ex-fumante: _____(anos que parou)
   ( ) fumante: _____(quantos por dia)

1. Profissão:_____
2. Escolaridade
   I. ( ) Não sabe ler ou escrever
   II. ( ) 1º grau incompleto
   III. ( ) 1º grau completo
   IV. ( ) 2º grau incompleto
   V. ( ) 2º grau incompleto
   VI. ( ) Universidade incompleta
   VII. ( ) Universidade completa
   VII. ( ) Pós-graduação
   IX. ( ) Não sei
3. Renda (salários): _____
4. Já fez hemodiálise? Quanto tempo?_____
5. Já realizou transplante renal? Quanto tempo?_____
6. Medicamentos que utiliza:_____
7. Apresenta alguma doença sistêmica?_____

ODONTOGRAMA



C- cariado
P- perdido
O - obturado

SIALOMETRIA

Saliva coletada sem estímulo por 5 min: _____ ml / 5 = _____ml/min

0,0 ml/min	Ausência de saliva (assialia)
0,1 ml/min	Hipossalivação severa
> 0,1 até 0,2 ml/min	Hipossalivação moderada
> 0,2 < 0,3 ml/min	Hipossalivação leve
0,3 a 0,6 ml/ min	Ideal
> 0,6 ml/min	Hiperssalivação