KIDNEY DISEASE, INCREASED BODY MASS INDEXES, AND ANTERIOR TEETH TREATMENT NEEDS

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Palavras-chave: Índice de Massa Corporal. CKD. Obesidade. Qualidade de Vida. Nutrição

RESUMO

Objetivo: O objetivo dessa série de avaliações foi testar a hipótese de que pessoas com doença renal têm mais necessidades de tratamento dos dentes anteriores. Esse efeito seria independente do risco aumentado de ser obeso. **Métodos**: Através do projeto da Faculdade de Odontologia da Universidade de Pittsburgh entitulado *Dental Registry and DNA Repository*, foi avaliada a história de tratamento em dentes anteriores em pacientes com doença renal. Quatro mil novecentos e oitenta e três indivíduos foram estudados. **Resultados**: Cento e três indivíduos reportaram ter doença renal e 1.424 pessoas tinham história de tratamento em dentes anteriores. Indivíduos com doença renal tiveram mais tratamento em dentes anteriores (p=0.001). Pessoas que reportaram doença renal também tiveram uma maior freqüência de obesidade, todavia necessidade de tratamento em dentes anteriores foi maior em indivíduos com doença renal, independente do índice de massa corporal. **Conclusão**: Doença renal crônica aumenta a necessidade de tratamrnto dos dentes anteriores, o que aumenta a chance de perda dentária e sugere que um protocol diferente para tartar pessoas com doença renal crônica seja uma medida justificada.

Keywords: Body Mass Index. CKD. Obesity. Quality of Life. Nutrition.

ABSTRACT

Objective: The purpose of this study was to test the hypothesis that individuals with kidney disease will have more dental issues affecting their anterior teeth. This effect on oral health would be independent from the effects of their higher frequency of obesity. **Methods**: Using the University of Pittsburgh School of Dental Medicine Dental Registry and DNA Repository project, anterior teeth treatment history was evaluated for patients with kidney disease. Four thousand nine hundred and eighty-three individuals were evaluated. Individuals with kidney disease were compared to individuals who did not present the condition. **Results**: One hundred and three individuals reported kidney disease and 1,424 had history of treatment of anterior teeth. Individuals with kidney disease had significant more anterior teeth treatments (p=0.001). Individuals who reported kidney disease also had a higher frequency of overweight individuals, but anterior teeth restoration needs were higher in all individuals with kidney disease, independent of their body mass index. **Conclusion**: Chronic kidney disease increases treatment needs of anterior teeth and potentially leads to worse oral health outcomes and warrants changes in protocols for treatment of individuals with chronic kidney disease.

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INTRODUCTION

Correlations between the loss of renal function early in life and developmental defects in enamel later in time have been reported in the literature a few times.[1-5] Children that show early deterioration of renal function are also affected by enamel hypoplasia in both their primary, and later, their permanent teeth. This defective enamel development has been attributed to issues involving the metabolism of vitamin D, which is known to affect the formation of teeth, and can be disrupted by renal osteodystrophy.[6] An important ion that is regulated by the kidneys is calcium. Nephrocalcinosis is a recessive autosomal disorder that is attributed to the impaired regulation of calcium, leading to its precipitation in the urinary collecting system. It was deduced that it is due to a mutation on the *FAM20A* gene, which was previously only thought to be associated with amelogenesis imperfecta, which is a disorder of the formation of enamel.[7-9]

Another factor affecting enamel in children is obesity. It was found that adolescents that were obese and overweight were 3.7 times more likely to develop caries in a three-year study.[10] Obesity has also proven to increase major risk factors for chronic kidney disease, like diabetes mellitus and hypertension. When adjustments were made for studying obesity and kidney disease for mediators of cardiovascular and metabolic effects from obesity,[11] obese participants still had poorer renal outcomes than those who were not obese. This implies that obesity may affect the function of kidneys in ways that are unrelated to these cardiovascular and metabolic complications. But there are also side effects of obesity that directly impact the kidneys. These include increased production of adiponectin, leptin, and resistin, among others. The changes in kidneys that occur due to obesity ultimately lead to glomerulomegaly and focal or segmental glomerulosclerosis. Obesity-related glomerulopathy has increased 10-fold between the years 1986 and 2000.[11]

Due to aesthetic procedures that hide the effects of the enamel defects previously mentioned, enamel alterations are sometimes more difficult to detect in adults. We aimed to determine if individuals with self-reported history of kidney disease, and later an increased body mass index (BMI), had more often the need for restoring anterior maxillary incisors, with the idea that dental treatments in anterior maxillary teeth are the consequence of a combination of improving aesthetic appearance and/or dealing with higher caries experience because potentially the enamel structure is weakened and more susceptible to demineralization under acidic challenge.

MATERIALS AND METHODS

At the time of this analysis, 4,983 subjects from the University of Pittsburgh School of Dental Medicine Dental Registry and DNA Repository [University of Pittsburgh Institutional Review Board (IRB) approval #0606091] were available for study. Starting in September of 2006, all individuals that seek treatment at the University of Pittsburgh School of Dental Medicine have been invited to be part of the registry. These individuals give written informed consent authorizing the extraction of information from their dental records. Information includes demographics, underlying medical history, dental history, medication intake, oral and dental diagnosis, and dental treatment needs. Of these patients, 103 of them reported having kidney disease.

Then, the individuals that possessed Body Mass Indexes (BMIs; N=2,763) were split into four different categories. The 'Underweight' category was made up of participants with BMIs less than 18. The 'Normal Weight' category was comprised of participants with BMIs that ranged from 18 to 24.9. 'Overweight' participants had BMIs between 25 and 29.9. Lastly, the group of participants whose BMIs were 30 and above were placed into the 'Obese' category. All of the participants were then further separated by which restorations they had, if any. The first restoration category includes 1 Surface, Anterior (tooth) (D2330), the second was 2 Surfaces, Anterior (tooth) (D2331), the third was 3 Surfaces, Anterior (tooth) (D2332), and the fourth category was 4+ Surfaces, or Incisal Angle involvement (D2335). Finally, these analyses were made considering if they had kidney disease or not. Chi-square was used to determine statistically significant differences with an alpha of 0.05.

RESULTS

Individuals with self-reported kidney disease (N=103) were for the most part males (58%), Whites [76%; others were Black (18%) or other groups (3%)], and had a mean age of 53.4 years. These data are similar to the data on the overall Dental Registry and DNA Repository project, which has 48% males, 65% Whites, 18% Blacks and the rest are other groups, and mean age of 43 years. Of the total 4,880 individuals without kidney disease, a total of 1,380 individuals had composite resins in anterior maxillary teeth (28%), in contrast with 44 (43%) individuals among those being in the subgroup of patients with kidney disease (N=103). **Table 1** illustrates these results found from comparing the frequencies of individuals affected with kidney disease and those not affected with kidney disease compared to the frequencies of individuals with a certain type of restoration or at least one

Table 1: *Distribution of individuals based on kidney disease status and type of composite resin restoration in anterior teeth.*

Composite Resin Type	Individuals Affected by Kidney Disease N = 103		Individuals without Kidney Disease N = 4,880		P-values
	N	Relative Frequency	N	Relative Frequency	
1 Surface, Anterior (D2330*)	27	0.26	483	0.10	0.0000001
2 Surfaces, Anterior (D2331*)	29	0.28	668	0.14	0.00003
3 Surfaces, Anterior (D2332*)	20	0.20	521	0.11	0.005
4+ Surfaces, or Incisal Angle (D2335*)	11	0.11	356	0.07	0.19
Any Type of Composite Resin	44	0.43	1,380	0.28	0.001

*Note: *Codes used for insurance purposes in the United States. Chi-square was used for all comparisons. Differences between the total N and individual lines are due to the fact the patients may have more than one type of restoration in their mouths.*

occurrence of any type of composite resin. There were significantly more individuals with 1, 2, and 3 Surface Anterior restorations who also had kidney disease than those with 1, 2, and 3 Surface Anterior restorations with no kidney disease. In addition, those with kidney disease were about 1.5 times more likely to have any type of composite resin over those with no kidney disease.

The increased anterior teeth treatment needs were higher in individuals with kidney disease, independent of their BMI. Table 2 shows the occurrences of different types of resin composites based on the BMI definitions, and the comparison between BMIs (as categorized by underweight, normal weight, overweight, and obese) and the occurrence of kidney disease. For each BMI category, statistically significant results were found that illustrate that as BMI increases, the occurrence of kidney disease increases also.

DISCUSSION

The frequency of individuals with any type of composite resin in the total study population was 28.58%, so the expected number of individuals in the group affected by kidney disease would have been expected to be around 29. Instead, the number was 44 (a frequency of 42.72%). Individuals with kidney disease had 53.57% more anterior composite resin restorations in comparison to individuals without kidney disease (p=0.001). The medical history data accessible for this project is self-report and this can be seen as a limitation for the study although we have no evidence to believe that in general people would not disclose that information to their dentists.

These results show that patients who have kidney disease will more often need anterior composite resin restorations that are possibly surrogates of enamel aesthetic concerns (i.e. enamel hypoplasia) or higher caries experience, as compared to the total population of patients who were in our study. In children, a strong correlation was shown in the primary dentition between the presence of enamel hypoplasia in maxillary incisors and caries experience in the same teeth.[12] The correlation between enamel hypoplasia and dental caries can also be seen in very-low birth weight children,[13] and in adolescents from India that were born from adolescent mothers.[14] Therefore, the higher frequency of maxillary incisors with composite resin restorations in individuals with kidney disease may also reflect a higher susceptibility to dental caries, which may be explained by a dental enamel more susceptible to acid demineralization. Our group has suggested that a genetic component exist for higher susceptibility to dental enamel to acquire caries lesions.[15-18] The fact that other factors that impact the development of enamel such as the presence of kidney disease also likely impact the susceptibility for dental caries, hence the multifactorial nature of the disease, which is likely influenced by more than one gene aside from the well-established environmental component.[19]

Furthermore, the results show that patients who have higher BMIs tend to have higher restoration frequencies. For an example, individuals in the obese category were 1.24 times more likely to have any type of composite resin rather than individuals who were not obese. They were 1.18 times more likely to have any type of restoration than individuals who were overweight, 1.21 times more likely to have any type of restoration than individuals who were normal weight, and 2.09 times more likely to have any type of restoration than individuals who were underweight. However, it remains important to understand that dental caries and BMI share several predisposing factors that may skew data, including diet, socioeconomic status, and lifestyle.[20]

As expected, we found an association between kidney disease and patients' BMI. The underweight population was 5.8 times less likely to also have kidney disease than the not-underweight population. The normal weight population was 3.0 times less likely to also have kidney disease than the not-normal weight population. On the other hand, the

***Table 2**: Distribution of individuals based on Bode Mass Index (BMI), kidney disease status and type of BMI vs. Composite Resin, Summary of Findings for:*

BMI vs. Composite Resin, Summary of Findings for Underweight Individuals

Composite Resin Type	Underweight Individuals N = 156		Not Underweight IndividualsN = 2,607		P-values
	N	Relative Frequency	N	Relative Frequency	
1 Surface, Anterior (D2330*)	20	0.13	549	0.21	0.01
2 Surfaces, Anterior (D2331*)	21	0.13	615	0.24	0.003
3 Surfaces, Anterior (D2332*)	17	0.11	426	0.16	0.07
4+ Surfaces, or Incisal Angle (D2335*)	12	0.08	286	0.11	0.2
Any Type of Composite Resin	36	0.22	1058	0.41	0.000007

BMI vs. Composite Resin, Summary of Findings for Normal Weight Individuals

Composite Resin Type	Normal Weight Individuals N = 998		Not Normal Weight IndividualsN = 1,765		P-values
	N	Relative Frequency	N	Relative Frequency	
1 Surface, Anterior (D2330*)	190	0.39	379	0.21	0.13
2 Surfaces, Anterior (D2331*)	211	0.29	425	0.24	0.25
3 Surfaces, Anterior (D2332*)	143	0.21	300	0.17	0.07
4+ Surfaces, or Incisal Angle (D2335*)	112	0.11	186	0.11	0.58
Any Type of Composite Resin	377	0.38	716	0.41	0.0000001

BMI vs. Composite Resin, Summary of Findings for Overweight Individuals

Composite Resin Type	Overweight Individuals N = 810		Not Overweight IndividualsN = 1,953		P-values
	N	Relative Frequency	N	Relative Frequency	
1 Surface, Anterior (D2330*)	175	0.39	394	0.20	0.4
2 Surfaces, Anterior (D2331*)	181	0.29	455	0.23	0.0000001
3 Surfaces, Anterior (D2332*)	130	0.21	313	0.16	0.0000001
4+ Surfaces, or Incisal Angle (D2335*)	72	0.11	226	0.12	0.04
Any Type of Composite Resin	314	0.39	779	0.40	0.58

BMI vs. Composite Resin, Summary of Findings for Obese Individuals

Composite Resin Type	Obese Individuals N = 799		Not Obese Individuals N = 1,964		P-values
	N	Relative Frequency	N	Relative Frequency	
1 Surface, Anterior (D2330*)	186	0.23	383	0.20	0.2
2 Surfaces, Anterior (D2331*)	231	0.29	405	0.21	0.000003
3 Surfaces, Anterior (D2332*)	151	0.19	292	0.15	0.009
4+ Surfaces, or Incisal Angle (D2335*)	104	0.13	194	0.10	0.01
Any Type of Composite Resin	367	0.46	726	0.37	0.00001

Body Mass Index vs. Kidney Disease, Summary of Findings on Restoration Frequency

BMI	Individuals Affected by Kidney Disease N = 96		Individuals without Kidney Disease N = 2,667		P-values
	N	Relative Frequency	N	Relative Frequency	
Underweight (BMI < 18)	1	0.01	158	0.06	0.04
Normal Weight (BMI 18 – 24.9)	15	0.16	983	0.37	0.0000001
Overweight (BMI 25 – 29.9)	33	0.34	777	0.29	0.0000001
Obese (BMI > 30)	47	0.49	752	0.28	0.0000001

*Note: *Codes used for insurance purposes in the United States. Chi-square was used for all comparisons. Differences between the total N and individual lines are due to the fact the patients may have more than one type of restoration in their mouths.*

overweight population was 1.3 times more likely to also have kidney disease than the not-overweight population. Lastly, the obese population was 2.4 times more likely to also have kidney disease than the not-obese population. These results support previous findings that suggest associations between kidney disease and elevated BMIs.[11]

The choice of analysis is worth mentioning. We did not perform a regression analysis because the goal was not to understand which among the independent variables were related to the dependent variable, and to explore these relationships, maybe even to infer causal effects. We know that obesity increases the chance of having kidney disease. The demonstration that the presence of an underlying kidney disorder leads to higher frequencies of restorative treatment of maxillary anterior teeth should be enough to provide evidence that individuals with chronic kidney disorders require personalized attention and likely different treatment approaches and preventive strategies to help stop worsening of oral health status.

Affection of anterior maxillary teeth that requires dental restorations could be the consequence of altered salivary flow.[21,22] Whereas anterior mandibular teeth are covered by the tongue and still may have more contact with saliva, decreased salivary flow may affect maxillary teeth more prominently, leading to higher experience of caries lesions and more dental treatment needs.

In conclusion, individuals with chronic kidney disease have more treatment needs of the anterior maxillary teeth. The identification of individuals with "caries predisposing enamel" not only would allow for personalizing preventive strategies, but also provide support for the popular belief of a correlation between "weak teeth" and having many "cavities."

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