

# Clinical Study of Tongue Coating in Patients with Chronic Kidney Disease Undergoing Chronic Dialysis Treatment

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**Abstract:** *The study assessed the extent of tongue coating in 70 patients with end-stage chronic kidney disease (CKD) undergoing chronic dialysis treatment. The objective findings were gathered using criteria for the extent of tongue coating and by means of FitScan Breath Checker. The Kendall tau-b correlation coefficient revealed a strong, positive and statistically significant correlation between the extent of tongue coating and the age group. Another close correlation was observed between the extent of tongue-coating and the degree of halitosis. The criteria for determining the extent of tongue coating are particularly suited to the study of bedridden patients and CKD patients.*

**Keywords:** end-stage chronic kidney disease, hemodialysis, tongue coating

## 1. Introduction

Chronic kidney disease (CKD) is characterized by structural and functional damage to the kidneys, leading to decreased glomerular filtration rate (GFR) [1, 2, 3]. Patients' reduced quality of life represents a significant health and social issue. According to 2012 data sufferers of CKD have reached over 50 million worldwide with a tendency of increasing incidence in nearly all countries [4, 5, 6].

End-stage CKD requires renal replacement therapy: peritoneal dialysis, chronic dialysis or kidney transplantation. A number of studies have shown that a prolonged replacement therapy leads to an increased risk of development of oral complications, linked to the underlying disease or as the result of its treatment [7]. Typical oral uremic manifestations are dry mouth, altered taste, uremic breath, etc. [7, 8, 9].

Tongue coating commonly shows the presence and nature of the pathogenic factors and often reflects the condition of some internal organs. Therefore, careful monitoring of changes on the tongue surface can be helpful in diagnosis. There are various methods of determining the extent of tongue coating. Xingzheng et al. introduced a new computer-aided tongue diagnosis system, while Kim et al. designed a tongue imaging system (DTIS) to acquire tongue surface images, measuring the percentage of tongue coating [10, 11]. Conventional tongue diagnostics involves visual inspection of the surface of the tongue, assessing the color, shape, moisture and movement of its coating and the characteristics of the dorsum of the tongue [12]. It is applicable for patients who have undergone a long-term dialysis treatment, mostly due to their dependence on the dialysis machine, the observation of a strict diet and the negative impact on the mental equilibrium of patients.

## 2. Objective

The study assessed the extent of tongue coating in patients with chronic kidney disease (CKD) undergoing chronic dialysis treatment.

## 3. Materials and Methods

The study was approved by the Ethics Committee of Research at the Medical University of Varna with Protocol No. 55/ 16 June2016. The clinical study involved 70 patients (37 women and 33 men) undergoing chronic dialysis treatment, aged  $60 \pm 28.5$  years (with the youngest participant being 32 and the oldest one being 89 years old), divided according to WHO age classification [13]. All patients underwent extra- and intraoral examinations. The objective findings were gathered through visual inspection of the dorsum of the tongue in a protruded position and were recorded using criteria, proposed by the researchers of the present study. The criteria were designed based on statistical analysis and the Index of Kojima et al. (1985) [14]. The tongue coating scores were suited for a primary oral examination and for bedridden patients whose overall state would not allow the use of another machine or time-consuming procedures. (Table 1, Figure 1a, 1b, 1c, 1d, 1e)

**Table 1:** Assessment criteria for the extent of tongue coating

Score	ASSESSMENT CRITERIA
1	No tongue coating visible
2	Tongue coating on the dorsum of the tongue visible at the tongue root (Radix linguae), extending to 2 mm from the median line (Linea mediana linguae)
3	Tongue coating visible from the tongue root to the middle of the dorsum and extending to 3 mm from the median line
4	Tongue coating visible over the middle of the dorsum, extending to 4 mm from the median line
5	Tongue coating visible down to the tip of the tongue and extending to 4 mm from the median line



Figure 1 (a): Patient A.P., 49 years old - Score 1



Figure 1(b): Patient G.D., 72 years old - Score 2



Figure 1 (c): Patient L.A., 68 years old - Score 3



Figure 1(d): Patient P.I., 43 years old - Score 4



Figure 1(e): Patient A.A., 32 years old - Score 5

Figure 1: Patients with various extent of tongue coating (1a, 1b, 1c, 1d, 1e)

The degree of halitosis was objectively recorded with FitScan Breath Checker (HC-212SF, Tanita Corporation, USA). The device measured the content of volatile sulfur compounds (VSCs), hydrogen sulphide (H<sub>2</sub>S), methyl mercaptan (CH<sub>3</sub>SH), dimethyl sulphide (CH<sub>3</sub>-S-CH<sub>3</sub>) and hydrocarbons in the oral cavity, taking readings in 5 levels: 0 - no odor, 1 - slight odor, 2 - moderate odor, 3 - heavy odor, 4 - strong odor, 5 - intense odor.

The statistical analysis of data was performed using SPSS Statistics software package for epidemiological and clinical research (V.16.00, November 2007). The following statistical methods were applied to confirm statistically significant correlations between qualitative variables: Chi-square (X<sup>2</sup>) test or Fisher's exact test (two-tailed test),

Kendall's coefficient of concordance, Spearman's coefficient.

#### 4. Results

The data revealed that 100% of CKD patients had a varying degree of tongue coating. The highest percentage of patients (31.51%) exhibited Score 4, closely followed by patients (31.03%) with Score 3, while 21.37% of participants were assigned Score 5.

The observations confirmed that age was a factor affecting the extent of tongue coating. (Figure 2)

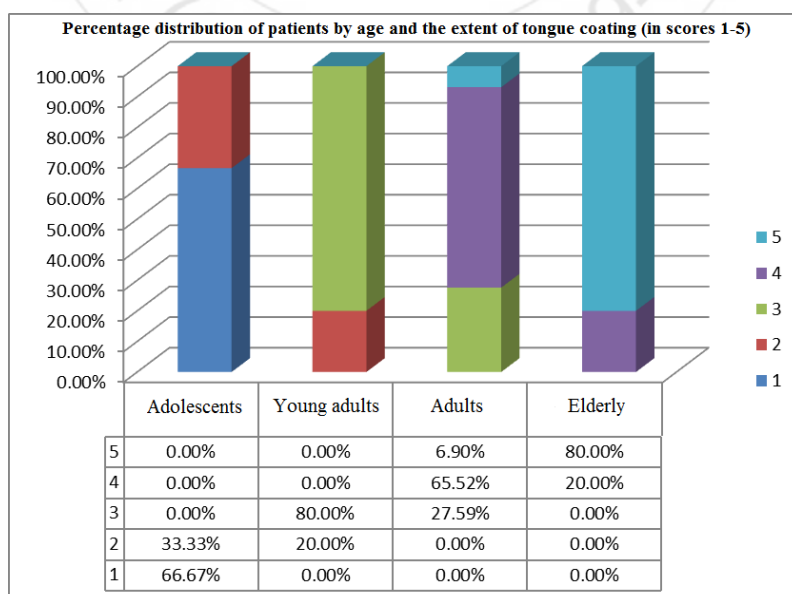


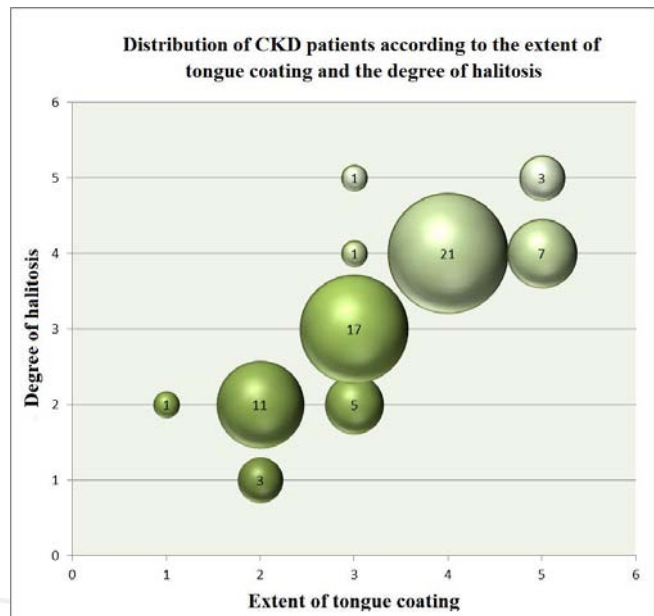
Figure 2: Percentage distribution of patients according to WHO age classification and the extent of tongue coating (in scores)

With patients' age the percentage of patients affected by a higher extent of tongue coating rose. There were no visible signs of the condition among 66.67% of adolescent participants, whereas 80% of the elderly were assigned the highest Score 5. Kendall's tau-b correlation coefficient showed that there was a strong, positive and statistically significant correlation between the extent of tongue coating and the age group ( $T_b=0.848, p<0.001$ ).

**Table 2:** Cross tabulation of data on the extent of tongue coating and WHO age classification

Tongue coating (in scores)		Age groups				Total
		Adolescents	Young adults	Adults	Elderly	
Score 1	Count	1	0	0	0	1
	% within row	100.0%	.0%	.0%	.0%	100.0%
	% within column	9.1%	.0%	.0%	.0%	1.4%
Score 2	Count	10	4	0	0	14
	% within row	71.4%	28.6%	.0%	.0%	100.0%
	% within column	90.9%	20%	.0%	.0%	20%
Score 3	Count	0	16	8	0	24
	% within row	.0%	66.7%	33.3%	.0%	100.0%
	% within column	.0%	80.0%	27.6%	.0%	34.3%
Score 4	Count	0	0	19	2	21
	% within row	.0%	.0%	90.5%	9.5%	100.0%
	% within column	.0%	.0%	65.5%	20.0%	30.0%
Score 5	Count	0	0	2	8	10
	% within row	.0%	.0%	20.0%	80.0%	100.0%
	% within column	.0%	.0%	6.9%	80.0%	14.3%
TOTAL	Count	11	20	29	10	70
	% within row	15.7%	28.6%	41.4%	14.3%	100.0%
	% within column	100.0%	100.0%	100.0%	100.0%	100.0%

The results from the correlation between gender and the degree of tongue coating displayed that male patients suffered less from the condition in any of the scores of tongue coating as opposed to female patients. Men were mostly assigned Score 3 (10.58%) and Score 4 (12.50%) according to the clinical appearance, described in Table 1. Conversely, the analysis of the results obtained from female patients revealed an inverse proportion between the number of women and the extent of tongue coating, i.e. most women (20.19%) showed clinical signs of the Score 1, while fewer women (5.77%) were assigned the highest Score 5. The chi-square test of independence (incorporating Yates' correction for continuity) proved that there was no statistically significant correlation between the extent of tongue coating and gender ( $\chi^2 (df = 1, n = 70) = 0.826, p = 0.36$ ). The high incidence of tongue coating in the Study group shifted the researchers' attention to look into a possible correlation with another oral manifestation, typical of CKD patient, namely halitosis. (Figure 3)



**Figure 3:** Distribution of patients according to extent of tongue coating and the degree of halitosis

The Kendall tau-b correlation coefficient showed a strong, positive and statistically significant correlation between the extent of tongue coating and the extent of halitosis ( $T_b = 0.842, p<0.001$ ).

## 5. Discussion

The criteria for determining the extent of tongue-coating are particularly suited to the study of bedridden patients and CKD patient. The conventional method for this patients group is easily accessible and is hence applicable in general practice. It contributes to the initial collection of information at the primary examination of patients where any further paraclinical tests (microbiological and biochemical) can be prescribed, if necessary. The correlations obtained from the study demonstrated statistical significance between extent of tongue coating and the degree of halitosis ( $T_b = 0.842, p<0.001$ ). The severity of tongue coating proved to be affected by patients' age. Using Kendall tau-b correlation coefficient statistically significant correlation was observed between the extent of tongue-coating and the age group ( $T_b = 0.848, p<0.001$ ). The present study causes scientific interest in the specific contributors to tongue coating and the conditions for their oral manifestation in the study group of CKD patients.

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