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Tongue Cleaning Habits and related Factors among Medical Students in 2024: A Cross-sectional Study

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Abstract:

Introduction: This study investigates tongue-cleaning habits, an often neglected aspect of oral hygiene, and the factors influencing these practices among medical students.

Materials and Methods: A cross-sectional survey of 961 Hanoi Medical University students used a questionnaire to collect data on demographics, tongue-cleaning frequency, tools, gag reflex, and related behaviors. Statistical analyses included logistic and linear regression models and chi-square tests to explore associations with tongue-cleaning habits.

Results: Only 65.76% of participants reported regularly practising tongue cleaning, with 47.81% doing it daily. The majority used toothbrushes (51.8%) rather than specialised tools. The gag reflex was prevalent (70.42%) and was significantly associated with reduced use of tongue brushes. Factors, such as female gender, perceived oral cleanliness, desire for information on tongue hygiene, and regular dental visits, were positively associated with better practices.

Discussion: Despite medical training, only two-thirds of students practiced tongue cleaning, and less than half did so daily. Females showed greater adherence but reported stronger gag reflexes. Motivators included perceived cleanliness and information-seeking, consistent with the Health Belief Model. Toothbrush reliance stemmed from accessibility and lack of guidance, while the gag reflex, linked to gender and beverage intake, hindered adherence. Tongue-cleaning behavior is influenced by demographic, perceptual, physiological, and educational factors.

Conclusion: Tongue cleaning among medical students is limited by the use of suboptimal techniques and tools. Gender, hygiene practices, gag reflex, and information-seeking shape habits. Integrating tongue hygiene education into medical curricula, guided by health behavior models, is crucial for enhancing practice and promoting sustained adoption.

Keywords: Tongue cleaning, Habits, Undergraduate medical students, Related factors, Gag reflex, Tools.

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1. INTRODUCTION

Oral hygiene is a fundamental aspect of overall health and well-being, playing a crucial role in preventing dental diseases and their associated systemic health issues [1]. While tooth brushing and flossing are frequently emphasised in oral health education, tongue cleaning remains a relatively neglected component despite its significant contribution to maintaining oral microbial balance and reducing halitosis [2]. The dorsal surface of the tongue is covered with numerous filiform papillae that provide an ideal environment for bacterial accumulation, food debris, and desquamated epithelial cells [3]. This accumulation, commonly referred to as tongue coating, is a significant source of intraoral halitosis and has been linked to the development of periodontal disease [4]. Additionally, regular tongue cleaning has been linked to improved taste perception and enhanced subjective oral hygiene [5].

Despite these benefits, adherence to tongue-cleaning practices remains low in many populations. For instance, Kishi *et al.* (2012) reported that only 35.4% of healthy adults in Japan engaged in tongue cleaning [6]. Matsuda *et al.* (2019) found that only 18.4% of respondents in Fukui Prefecture practised daily tongue cleaning with a toothbrush, while Yadav *et al.* (2023) reported a higher rate of 53.8% among patients in Kathmandu, Nepal, although the practice remained inconsistent [7, 8]. These findings suggest that even where awareness may exist, sustained and technically adequate practice is often lacking. Globally, most studies on tongue hygiene remain limited in scope, usually focusing narrowly on prevalence rates [6]. More nuanced aspects, such as the frequency of cleaning, the type of tools used, the technique, and perceived barriers like the gag reflex, have not been fully explored. In particular, few studies have utilised health behaviour theories to analyse how individual attitudes, perceptions, and contextual influences shape tongue-cleaning habits.

In the Vietnamese context, tongue cleaning is rarely addressed as a standalone behaviour within oral hygiene practices. To date, no published study has systematically investigated tongue-cleaning habits or related behavioural factors in the Vietnamese population. This study is, therefore, the first to explore these behaviours among medical students, a group expected to exemplify healthy practices and serve as future providers of oral health education [9]. Furthermore, there is a critical need to understand how factors, such as gender, perceived cleanliness, knowledge-seeking behaviours, and physiological responses (*e.g.*, the gag reflex), influence tongue-cleaning practices. Gaining such insights among healthcare students not only enriches the local evidence base but also supports the design of more comprehensive and behaviorally informed oral health education strategies. Accordingly, this study aims to investigate the tongue-cleaning habits among medical students and to identify the demographic and behavioural factors associated with these habits.

2. MATERIALS AND METHODS

2.1. Study Design and Participants

A descriptive cross-sectional study was conducted at Hanoi Medical University (HMU), Hanoi, Vietnam. The study population included undergraduate students currently enrolled at HMU at the time of data collection. Participants were recruited using a convenience sampling approach across all academic years. Students were eligible for inclusion if they were actively enrolled and had voluntarily consented to participate, and were between 18 and 24 years of age. Exclusion criteria included post-graduate students, individuals not enrolled at HMU, those who declined consent, and students with significant physical or mental health conditions that might interfere with participation.

Recruitment and data collection were conducted over two weeks in December 2024. Data were obtained using a self-administered structured questionnaire.

The sample size of 961 students was determined based on both statistical requirements and practical considerations. Using the standard formula for estimating a single population proportion in cross-sectional studies:

$$n = z^2_{1-\alpha/2} \frac{P(1-p)}{d^2}$$

With:

- Z = 1.96
- p = 0.5
- d = 0.05

The minimum sample size required was estimated to be 385 students. However, to improve statistical power and account for potential issues, such as non-response, incomplete answers, and sampling variability across academic years and majors, the research team intentionally aimed to recruit a much larger sample. The final sample consisted of 961 respondents, surpassing the minimum required by nearly 2.5 times. This larger sample size enabled more accurate prevalence estimates, allowed for subgroup analyses, and supported the use of multivariate regression modelling with multiple predictors. Additionally, the expanded sample enhanced the generalisability of the findings within the university population. This approach reflects best practices in observational health research, where larger-than-minimum samples are generally used to increase the robustness and reliability of results.

2.2. Questionnaire Survey

The questionnaire was developed by selectively adapting and translating items from the original instruments of Kishi *et al.* (2012), Matsuda *et al.* (2019), and Yadav *et al.* (2023) [6, 7, 8]. Specifically, Kishi *et al.* conducted a cross-sectional survey of 479 healthy individuals in Iwate Prefecture, Japan, assessing the prevalence and frequency of tongue-cleaning habits, preferred tools, and associated factors using structured questions. Matsuda *et al.* implemented their questionnaire among 1,014 outpatients in Fukui Prefecture, Japan,

focusing on the regularity of tongue cleaning, areas of the tongue cleaned, and motivations for the behaviour. Meanwhile, Yadav *et al.* surveyed 312 patients at a dental hospital in Kathmandu, Nepal, using a set of items that investigated tongue-cleaning frequency, methods, barriers, and socio-demographic data. Based on these validated sources, the current research team selected, modified, and reorganised relevant items to fit the characteristics of medical student participants. A preliminary version of the questionnaire was pilot-tested with 30 study participants to evaluate clarity, comprehensibility, and internal consistency. Feedback from participants and the results of the pilot analysis were used to refine the instrument, resulting in the finalised version used in the main study.

The questionnaire consisted of 15 structured items, divided into two sections. The first section focused on assessing tongue-cleaning behaviours, which served as the primary outcome variables. These included whether participants practiced tongue cleaning (Yes/No), the frequency of cleaning per week (ordinal scale), the type of tool used (toothbrush, tongue scraper, or tongue brush), the extent of tongue coverage during cleaning (entire tongue *vs*. anterior portion only), and the occurrence of a gag reflex during the process (Yes/No).

The second section captured potential explanatory variables or predictors. These comprised the desire to receive additional information about tongue hygiene, perceived oral cleanliness, self-reported halitosis, regular consumption of carbonated or alcoholic beverages, the habit of attending regular dental check-ups, and the adoption of other oral hygiene practices, such as tooth brushing, flossing, or using mouthwash. Except for cleaning frequency, which was treated as an ordinal variable, all remaining variables were coded as binary (Yes/No).

2.3. Data Collection

The study employed a convenience sampling strategy, in which participants were recruited from various academic years and majors at Hanoi Medical University. The questionnaire contained only items relevant to the research objectives and did not include any questions that could reveal personal identifiers. Incomplete or inaccurately completed responses were excluded from the final dataset. All participants received the same version of the questionnaire regardless of gender, academic year, or major, ensuring comparability of assessment methods across groups.

To minimise potential sources of bias, several measures were implemented during the design and data collection process. Selection bias was addressed by recruiting participants from all academic years and majors at Hanoi Medical University, using a convenience sampling method to ensure diverse representation. To minimise information and recall bias, the questionnaire focused on current tongue-cleaning behaviours rather than past experiences and employed structured, clearly worded items. Social desirability bias was mitigated by ensuring that participation was voluntary, anonymous, and had no academic consequences. Participants were informed that there were no right or wrong answers and that honest responses were crucial to the validity of the study. Incomplete or inconsistent responses were excluded from the final analysis to enhance data integrity.

2.4. Statistical Analysis

Data were cleaned and entered using Microsoft Excel, then analysed with Stata 16 software. Descriptive statistics were used to present the prevalence of tongue-cleaning practices, the frequency of tongue cleaning, the proportion of participants experiencing a gag reflex, the distribution of tongue-cleaning techniques, and the proportion of different tools used for tongue cleaning. Multivariate logistic regression and Chi-square tests were employed to examine the associations between the independent variables and the following outcomes: tongue-cleaning practice, occurrence of the gag reflex during tongue cleaning, Tongue-cleaning method (entire tongue *vs*. partial), and Tool selection for tongue cleaning. Additionally, linear regression analysis was conducted to examine the impact of related factors on the frequency of tongue cleaning. The final dataset included only fully completed responses. Statistical significance was defined as $p < 0.05$ for all analyses.

2.5. Ethical Approval

This study was approved by the Institutional Review Board of Hanoi Medical University with registration number ĐTSV2024/*GCN-HMUIRB*. The approval date was 17th December 2024. All procedures were conducted in accordance with institutional guidelines and the ethical standards outlined in the 1964 Helsinki Declaration and its subsequent amendments. Participant confidentiality was strictly maintained, and all collected data were anonymised to ensure privacy and data security.

3. RESULTS

A total of approximately 3,000 undergraduate students were enrolled at Hanoi Medical University during the data collection period and were considered potentially eligible for the study. Of these, around 1,050 students were approached *via* convenience sampling. After applying inclusion and exclusion criteria, 961 students voluntarily consented to participate and completed the questionnaire thoroughly. No participants were lost to follow-up or excluded from analysis due to missing or incomplete data.

Figure **1** presents the demographic characteristics of the study participants. Among the 961 undergraduate students surveyed, 46.2% were male and 53.8% were female, indicating a slightly higher proportion of female participants. Regarding age distribution, the majority of respondents (81.3%) were between 18 and 20 years old, whereas 18.6% were above 20 years old.

Figure **2** illustrates that among the respondents, 65.76% reported practising tongue cleaning. Regarding the gag reflex, 70.42% of participants experienced a gag reflex during tongue cleaning. In terms of cleaning technique, 56.03% of participants reported cleaning the entire surface of the tongue.

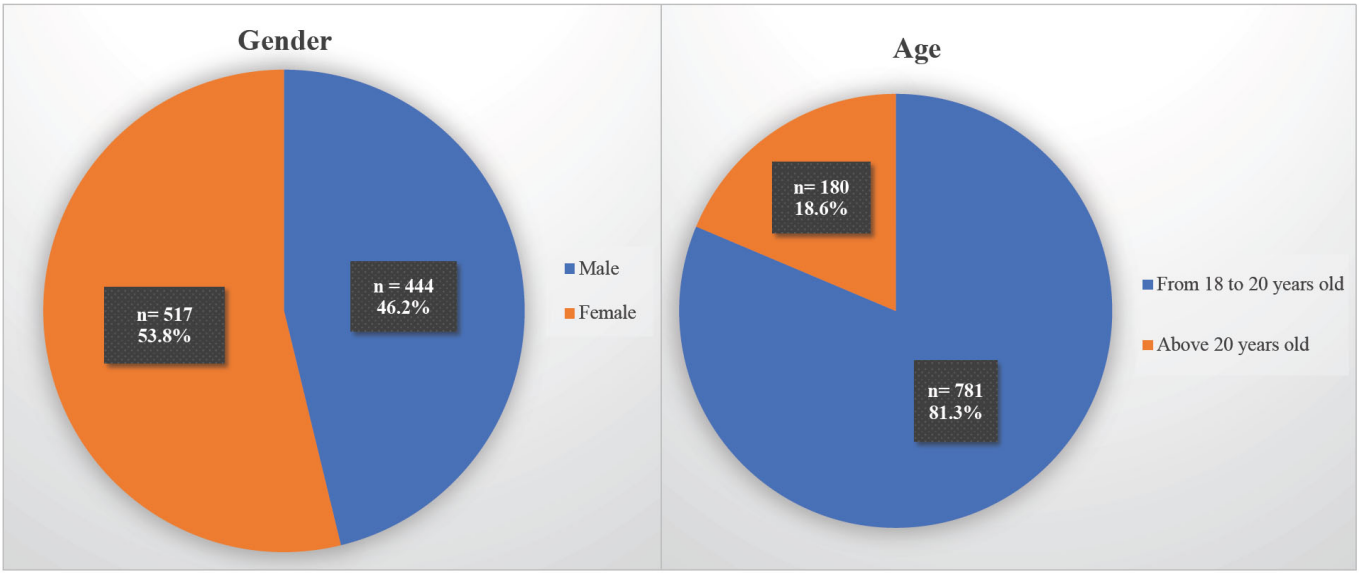

Fig. (1). Characteristics of the study sample.

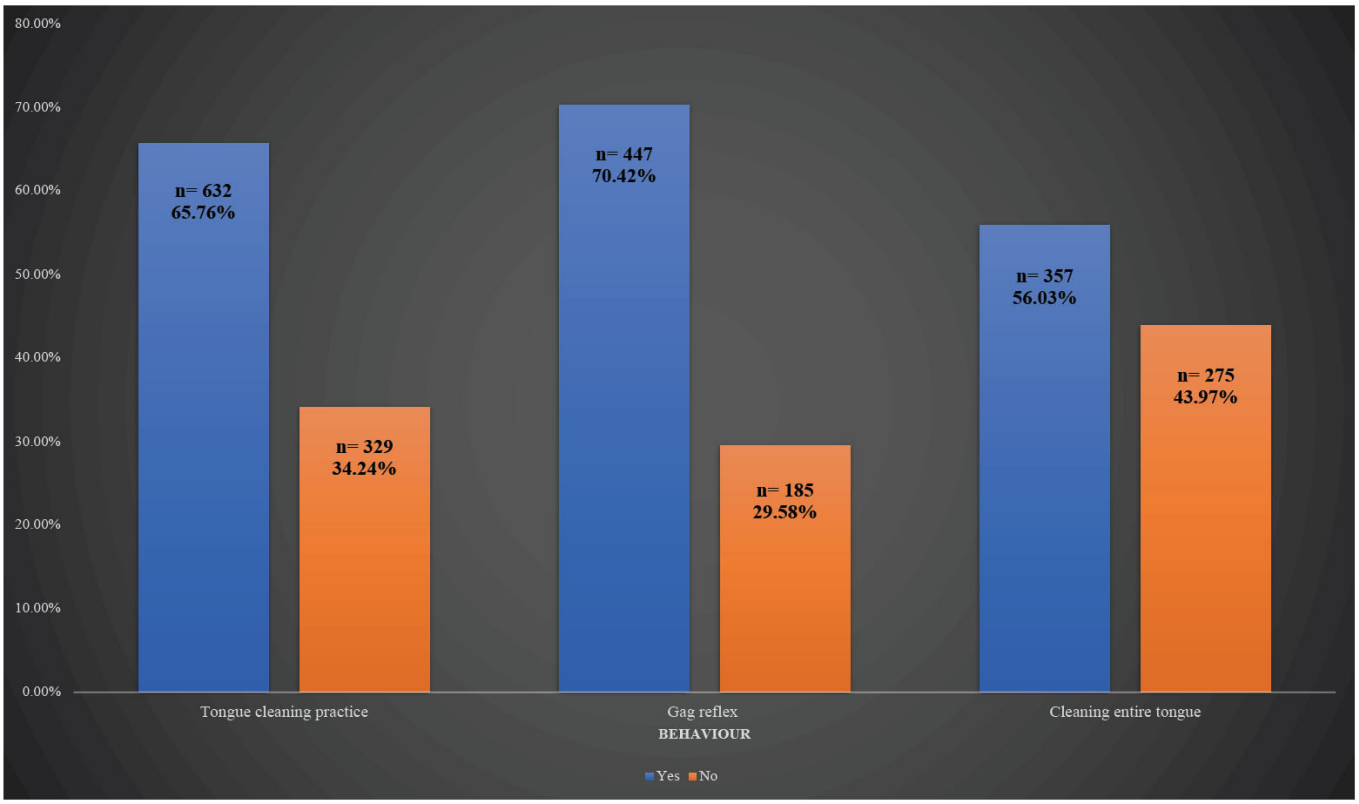

Fig. (2). Proportion of 'Yes' or 'No' for tongue-cleaning practice, Gag Reflex, and tongue-cleaning methods.

Figure **3** illustrates the frequency of tongue cleaning per week among the participants who practised tongue cleaning. The most common frequency reported was daily cleaning, with 47.81% of participants cleaning their tongue every day. Additionally, 24.45% of participants cleaned their tongue one or two days per week, 17.08%

cleaned three or four days per week, and 10.66% cleaned five or six days per week.

Figure **4** displays the types of tools used by participants for tongue cleaning. Among those who practiced tongue cleaning, the most commonly used tool was the toothbrush, reported by 51.8% of participants. This was followed by tongue scrapers, used by 30.0%, and tongue brushes, used by 18.2%.

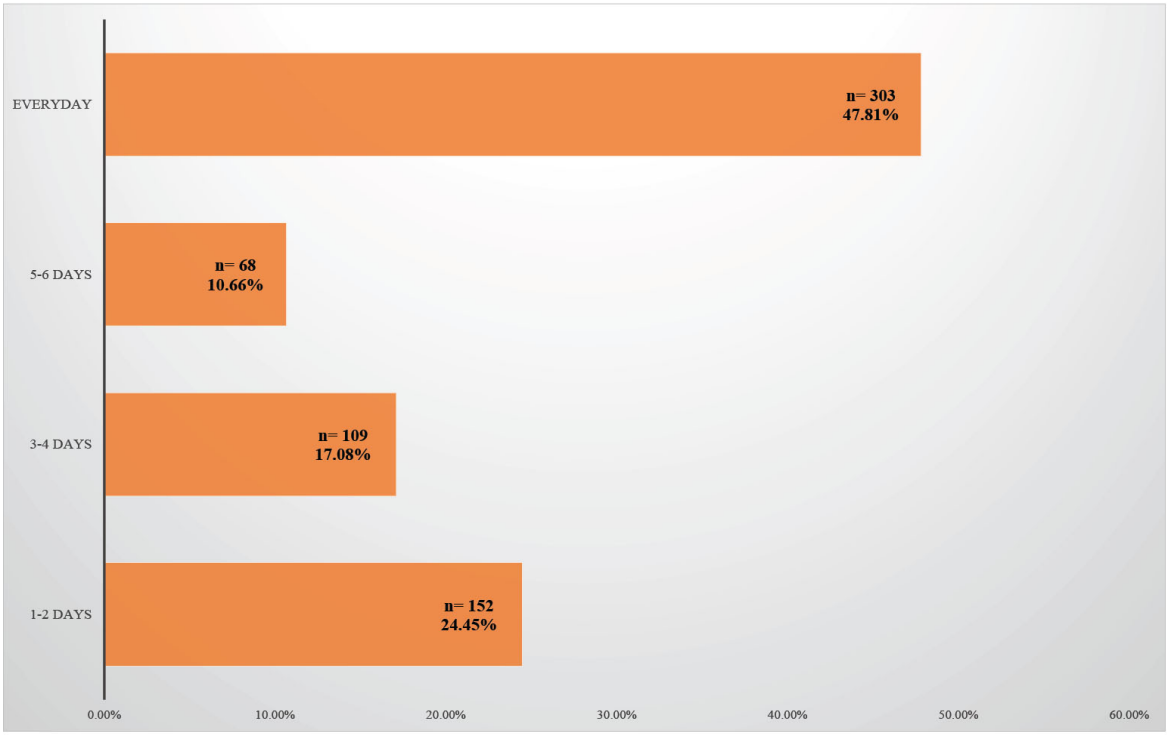

Fig. (3). The frequency of tongue cleaning per week.

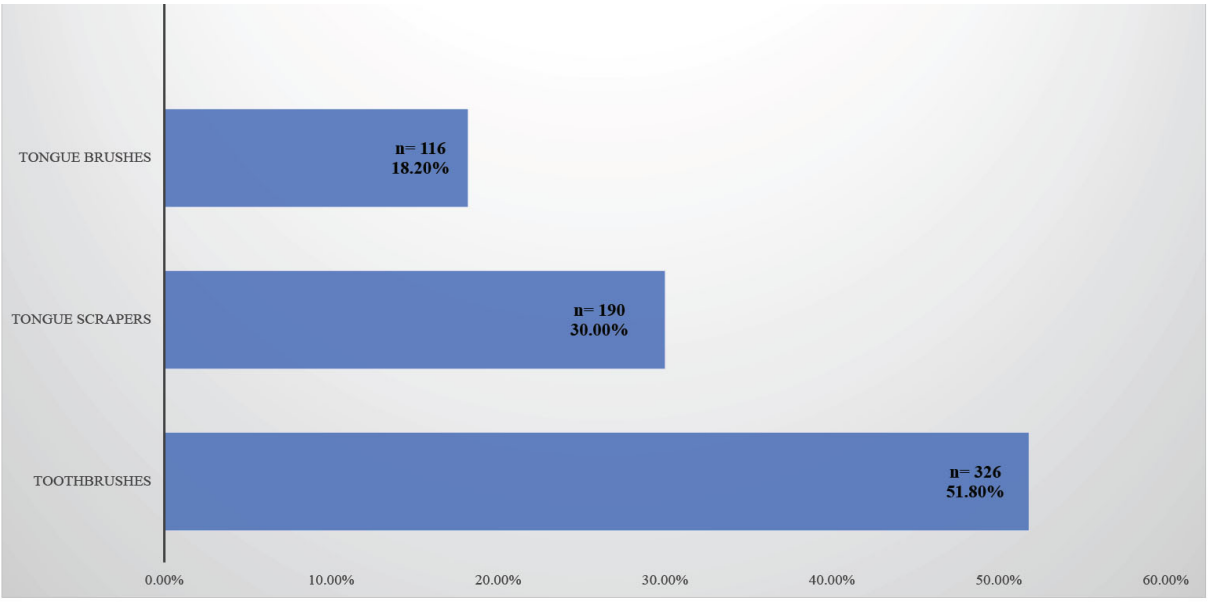

Fig. (4). Tools used for tongue cleaning.

Table 1 showed that female students were significantly more likely to practice tongue cleaning ($p < 0.001$), report gag reflex ($p < 0.05$), and clean the entire tongue ($p < 0.05$). Tongue-cleaning practice was also associated with a stronger desire for information ($p < 0.001$), better oral hygiene practices ($p < 0.001$), regular dental check-ups ($p < 0.01$), and a higher perceived level of oral cleanliness ($p < 0.001$). Gag reflex was further linked to beverage consumption ($p < 0.05$), while cleaning the entire tongue was also related to beverage consumption ($p < 0.05$) and dental check-ups ($p < 0.05$). Other variables, including age and breath perception, showed no significant associations.

Table 2 showed that tongue-cleaning frequency was not significantly associated with gender, age, desire for information, oral hygiene methods, beverage consumption, or gag reflex (all $p > 0.05$). However, students who attended regular dental check-ups cleaned their tongue more frequently ($p < 0.05$). Breath perception showed a strong association, with individuals who perceived no bad breath being more likely to clean their tongue more often ($p < 0.001$). Similarly, higher perceived oral cleanliness was associated with a greater frequency ($p < 0.001$). Cleaning the entire tongue was also strongly associated with a higher frequency of tongue cleaning ($p < 0.001$).

Table 1. Distribution of independent variables by tongue-cleaning practice, gag reflex, and tongue-cleaning methods.

Independent Variable	Dependent Variable					
	Tongue-cleaning Practice		Gag Rreflex		Cleaning the Entire Tongue	
	Yes (n = 632)	No (n = 329)	No (n = 185)	Yes (n = 447)	No (n = 275)	Yes (n = 357)
Gender *(Male/Female)*	254/378	190/139	91/94	168/271	126/149	133/224
	p < 0.001		***p < 0.05***		***p < 0.05***	
Age *(From 18 to 20 years old/Above 20 years old)*	506/126	276/53	151/34	354/93	216/59	289/68
	$p > 0.05$		$p > 0.05$		$p > 0.05$	
Desire to receive information on tongue hygiene *(No/Yes)*	157/475	122/207	53/132	105/342	64/211	94/263
	p < 0.001		$p > 0.05$		$p > 0.05$	
Oral hygiene methods *(No/Yes)*	44/854	63/266	16/169	29/418	17/255	28/329
	p < 0.001		$p > 0.05$		$p > 0.05$	
Consumption of carbonated and alcoholic drinks behavior *(No/Yes)*	72/558	27/301	30/155	42/403	40/235	32/323
	$p > 0.05$		***p < 0.05***		***p < 0.05***	
Regular dental check-ups *(No/Yes)*	98/534	77/252	22/163	75/372	56/219	41/316
	p < 0.01		$p > 0.05$		***p < 0.05***	
Breath-smelling perception *(No/Yes)*	525/107	268/61	155/30	367/80	211/64	311/46
	$p > 0.05$		$p > 0.05$		-	
Oral cleanliness perception *(No/Yes)*	242/390	167/162	68/117	178/269	118/157	128/229
	p < 0.001		$p > 0.05$		$p > 0.05$	
Gag reflex *(No/Yes)*	-	-	-	-	73/202	116/241
	-		-		$p > 0.05$	
Cleaning the entire tongue *(No/Yes)*	-	-	73/112	208/239	-	-
	-		$p > 0.05$		-	

Table 2. Distribution of independent variables by tongue-cleaning frequency.

Independent Variable	Tongue-cleaning Frequency			
	1-2 days (n = 152)	3-4 days (n = 109)	5-6 days (n = 68)	Everyday (n = 303)
Gender *(Male/Female)*	70/82	47/62	22/46	116/187
	$p > 0.05$			
Age *(From 18 to 20 years old/Above 20 years old)*	129/23	86/23	54/14	240/63
	$p > 0.05$			
Desire to receive information on tongue hygiene *(No/Yes)*	30/122	27/82	18/50	79/226
	$p > 0.05$			
Oral hygiene methods *(No/Yes)*	12/140	8/101	2/66	18/285
	$p > 0.05$			
Consumption of carbonated and alcoholic drinks behavior *(No/Yes)*	14/137	13/95	7/61	33/272
	$p > 0.05$			

(Table 2) contd.....

Independent Variable	Tongue-cleaning Frequency			
	1-2 days (n = 152)	3-4 days (n = 109)	5-6 days (n = 68)	Everyday (n = 303)
Regular dental check-ups *(No/Yes)*	34/118	15/94	10/58	34/271
	p < 0.05			
Breath-smelling perception *(No/Yes)*	111/41	82/27	60/8	274/29
	p < 0.001			
Oral cleanliness perception *(No/Yes)*	72/80	49/60	16/52	104/201
	p < 0.001			
Gag reflex *(No/Yes)*	32/120	30/79	22/46	97/206
	$p > 0.05$			
Cleaning the entire tongue *(No/Yes)*	101/52	50/59	29/39	97/206

Note: $p < 0.001$.

Table **3** illustrates the multivariate logistic regression model used to analyze the relation between tongue-cleaning practices, gag reflex percentage, tongue-cleaning methods, and the related factors. Under the same conditions for other variables, the following groups are more likely to have tongue-cleaning practice: “Females (95%CI:1.39-2.45)”, “Requiring information on tongue hygiene (95%CI: 1.27-2.33),” “Using tools other than a toothbrush for oral hygiene (95%CI: 1.71-4.09)” and “Having a clean oral cavity (95%CI: 1.21-2.15).”

The following groups have a higher tendency to experience gag reflex: “Females (95%CI: 1.16-2.37),” “Having consumed colored and alcoholic beverages in the past six months (95%CI: 1.11-3.22).”

Participants who used tools other than a toothbrush were significantly more likely to clean the entire tongue (OR = 2.07, 95% CI: 1.20–3.56, $p < 0.01$), as were those with higher cleaning frequency (OR = 1.52, 95% CI: 1.32–1.74, $p < 0.001$). Conversely, those using toothbrushes for tongue cleaning had a lower likelihood of complete tongue cleaning (OR = 0.42, 95% CI: 0.21–0.84, $p < 0.05$).

Table **4** illustrates that the multivariate linear regression model indicates that using tools other than a toothbrush for oral hygiene increases tongue-cleaning frequency by 0.47 units, having bad breath decreases it by 0.59 units, and perceiving a clean oral cavity increases it by 0.22 units. Using specialized tongue-cleaning tools decreases the frequency of tongue cleaning by 0.14 units, whereas cleaning the entire tongue increases it by 0.59 units.

Table **5** illustrates the multivariate logistic regression model used to analyse the usage rates of different tongue-cleaning tools and related factors. Under the same conditions for other variables, participants who had these aspects: “applying various tools for oral hygiene (95%CI:0.10-0.47)”, “having visited a dentist in the past six months (95%CI:0.35-0.92)”, and “cleaning the entire tongue (95%CI:0.31-0.62)” were less likely to choose a toothbrush for tongue cleaning. Cleaning the whole tongue increases the possibility of selecting tongue scrapers (95%CI:1.20-2.94) and tongue brushes (95%CI:1.16-2.45). Individuals who experience a gag reflex tend to avoid choosing tongue brushes for tongue cleaning (95%CI:0.42-0.89). Lastly, students who clean their tongue more frequently tended to use toothbrushes (95%CI:1.05-1.39).

Table 3. Correlation between tongue cleaning practice, gag reflex, tongue-cleaning methods, and related factors.

Independent Variable	Dependent Variable		
	Tongue-cleaning Practice	Gag Reflex	Tongue-cleaning Methods
Gender	1.84 (1.39-2.45)***	1,66 (1.16-2.37)**	1.30 (0.92-1.84)
Age	1.21 (0.83-1.75)	1.32 (0.84-2.07)	0.80 (0.53-1.23)
Desire to receive information on tongue hygiene	1.72 (1.27-2.33)***	1.23 (0.82-1.84)	0.83 (0.56-1.23)
Oral hygiene methods	2.65 (1.71-4.09)***	1.25 (0.63-2.50)	0.42 (0.21-0.84)*
Consumption of carbonated and alcoholic drinks behavior	0.68 (0.41-1.10)	1.89 (1.11-3.22)*	2.07 (1.20-3.56)**
Regular dental check-ups V	1.39 (0.97-1.99)	0.73 (0.43-1.25)	1.40 (0.87-2.27)
Breath-smelling perception	1.23 (0.84-1.81)	1.02 (0.62-1.68)	0.75 (0.47-1.18)

(Table 3) contd.....

Independent Variable	Dependent Variable		
	Tongue-cleaning Practice	Gag Reflex	Tongue-cleaning Methods
Oral cleanliness perception	1.61 (1.21-2.15)**	0.94 (0.65-1.36)	1.18 (0.83-1.68)
Tongue-cleaning frequency	-	0.87 (0.75-1.02)	1.52 (1.32-1.74)***
Tongue-cleaning tools	-	0.80 (0.65-1.36)*	1.52 (1.24-1.85)***
Gag reflex	-	-	0.80 (0.55-1.17)
Tongue-cleaning methods	-	0.80 (0.55-1.16)	-

Note: ***p <0.001; **p <0.01; *p <0.05.

Table 4. Correlation between tongue cleaning frequency and related factors.

Independent Variable	Tongue-cleaning Frequency
Gender	0.99 (-0.09;0.29)
Age	0.12 (-0.11;0.36)
Desire to receive information on tongue hygiene	-0.04 (-0.25;0.18)
Oral hygiene methods	0.48 (0.10;0.85)*
Consumption of carbonated and alcoholic drinks behavior	0.01 (-0.29;0.31)
Regular dental check-up behaviour	0.23 (-0.04;0.49)
Breath-smelling perception	-0.59 (-0.84;-0.34)***
Oral cleanliness perception	0.22 (0.03-0.41)*
Tongue-cleaning tools	-0.14 (-0.25; -0.03)*
Gag reflex	-0.18 (-0.39; 0.02)
Tongue-cleaning methods	0.59 (0.40; 0.79)***

Note: ***p <0.001; **p <0.01; *p <0.05.

Table 5. Correlation between tongue-cleaning tools and related factors.

Independent Variable	Dependent Variable		
	Using Toothbrushes	Using Tongue Scrapers	Using Tongue Brushes
Gender	0.93 (0.66-1.30)	1.19 (0.77-1.82)	0.97 (0.68-1.39)
Age	0.88 (0.58-1.32)	1.17 (0.71-1.95)	1.03 (0.66-1.61)
Desire to receive information on tongue hygiene	0.73 (0.49-1.06)	1.01 (0.62-1.64)	1.44 (0.94-2.21)
Oral hygiene methods	0.21 (0.10-0.47)***	1.99 (0.74-5.33)	5.12 (1.76-14.89)**
Consumption of carbonated and alcoholic drinks behavior	0.98 (0.58-1.68)	1.04 (0.51-2.10)	0.99 (0.55-1.78)
Regular dental check-up behavior	0.57 (0.35-0.92)*	1.41 (0.74-2.70)	1.55 (0.91-2.64)
Breath-smelling perception	1.12 (0.71-1.75)	0.70 (0.38-1.29)	1.12 (0.69-1.82)
Oral cleanliness perception:	1.22 (0.87-1.72)	0.85 (0.56-1.31)	0.90 (0.63-1.30)
Tongue-cleaning frequency	1.21 (1.05-1.39)*	0.90 (0.75-1.07)	0.87 (0.75-1.01)
Gag reflex	1.26 (0.88-1.82)	1.43 (0.89-2.31)	0.61 (0.42-0.89)*
Tongue-cleaning methods	0.44 (0.31-0.62)***	1.88 (1.20-2.94)**	1.68 (1.16-2.45)*

Note: ***p <0.001; **p <0.01; *p <0.05.

4. DISCUSSION

This study reveals a concerning gap in tongue-cleaning behaviour among medical students, despite their expected role in modelling and promoting oral health. Only 65.76% of participants reported practising tongue cleaning, and less than half (47.81%) did so daily. At the same time, this prevalence is higher than the 18.4% daily rate found in Japan (Matsuda *et al.,* 2019) and above the 41% reported in Italy (Abati *et al.,* 2023) [7, 10]. The discrepancy across countries likely reflects differences in cultural norms, exposure to health education, and public health messaging. The finding that even medical students demonstrate insufficient adherence suggests that tongue hygiene is less effective than tooth brushing and flossing.

Gender differences emerged as notable predictors of tongue-cleaning behaviour. Female students were more likely to clean their tongues (OR = 1.84), which may reflect a higher level of health consciousness and aesthetic motivation. This aligns with broader gender-based health behaviour research, where women tend to engage more in preventive health practices, possibly due to a greater internalisation of health norms, societal expectations about cleanliness and self-care, and heightened sensitivity to social cues, such as perceived breath odour [11]. Additionally, aesthetic concerns related to oral appearance and freshness may further motivate females to adopt more comprehensive oral hygiene routines, including tongue cleaning.

Students who expressed a desire for more information about tongue cleaning (OR = 1.72) and those who perceived their mouths as cleaner after cleaning were more likely to engage in the behaviour regularly. According to the Health Belief Model, information-seeking behaviour often reflects increased perceived susceptibility and awareness, which can motivate preventive practices [12]. Individuals actively seeking knowledge may view tongue cleaning as a preventive measure that enhances both their health and social confidence, thereby increasing their likelihood of engaging in the behaviour [13]. Similarly, the perception of oral cleanliness after cleaning acts as a reinforcing experience that enhances self-efficacy and perceived benefits, two key drivers of sustained health practices. Conversely, participants who reported halitosis were less likely to clean regularly, possibly reflecting low self-efficacy or frustration with perceived ineffectiveness [14]. These findings support the Health Belief Model's emphasis on perceived benefits, self-efficacy, and cues to action as determinants of health behaviour [12].

Participants with comprehensive oral hygiene routines were more likely to clean their entire tongues since this technique has been shown to reduce tongue coating and volatile sulfur compound (VSC) levels more effectively than cleaning only the anterior region [2]. This clustering of health behaviours reflects the phenomenon of behavioural co-occurrence, where individuals who adopt one health-promoting behaviour are more likely to embrace others [15]. It also suggests possessing stronger perceived behavioral control and intention, as framed in the Theory of Planned Behavior, enabling individuals to translate health knowledge into sustained action [16]. Frequent engagement with multiple oral care practices may enhance exposure to dental professionals and educational resources, thereby reinforcing the importance of tongue cleaning, as well as the use of accurate tongue-cleaning techniques [17].

The ideal frequency and duration for effective tongue cleaning remain uncertain, therefore, further studies should focus on this topic [18]. However, the results demonstrate that employing a whole-tongue cleaning technique significantly increases the frequency of cleaning ($\beta = 0.59$, $p < 0.001$). From a behavioral science perspective, this effect likely results from enhanced perceived competence, which reinforces motivation and habit formation [19]. According to Cognitive Evaluation Theory, when individuals perceive themselves as skilled in a task, their intrinsic motivation increases, making repetition more likely [19]. Similarly, participants who practiced multiple oral hygiene behaviors reported a higher frequency of tongue cleaning ($\beta = 0.48$, $p < 0.05$). This corresponds with the concept of behavioral clustering, where engagement in one health-promoting activity increases the likelihood of others [20]. A positive perception of oral cleanliness after tongue cleaning was also a significant predictor ($\beta = 0.22$, $p < 0.05$), reinforcing the idea that self-efficacy and immediate feedback are crucial for maintaining healthy behaviors. Conversely, participants who reported halitosis cleaned significantly less frequently ($\beta = -0.59$, $p < 0.001$), likely due to discouragement stemming from perceived ineffectiveness. Lastly, the use of specialized tongue-cleaning tools was unexpectedly associated with a slight decrease in frequency ($\beta = -0.14$, $p < 0.05$), suggesting that practical discomfort or unfamiliarity may deter regular use of these evidence-based instruments.

Despite the demonstrated effectiveness of tongue scrapers and specialized brushes, most students (51.8%) used regular toothbrushes for cleaning their tongues. This preference likely reflects accessibility, familiarity, and lack of formal instruction [21]. Prior research has shown that toothbrushes are less effective than scrapers in removing tongue coating and reducing volatile sulfur compounds [22]. The choice of tool was further associated with technique and prior experience. Those with good technique were less likely to use toothbrushes (OR = 0.21) and more likely to adopt specialized tools. Dental consultations appeared to influence behavior as well, since students who had visited a dentist recently were less reliant on toothbrushes (OR = 0.57), suggesting professional advice may shape tool selection by increasing awareness, providing hands-on instruction, and reinforcing behavioral control through trusted guidance [6]. The presence of a gag reflex (OR = 0.61, $p < 0.05$) was associated with lower use of tongue brushes, indicating a physiological barrier. Implementing stepwise desensitisation techniques, such as gradual posterior progression, can help students overcome this obstacle.

Finally, participants who maintained comprehensive oral hygiene habits were over five times more likely to use scrapers (OR = 5.12, p. < 0.01) and significantly less likely to use toothbrushes (OR = 0.21, $p < 0.001$). This suggests that oral health literacy and confidence are crucial in informing the selection of evidence-based tools.

The gag reflex, reported by 70.42% of participants, emerged as a substantial barrier. It was associated with lower use of tongue brushes (OR = 0.61) and a reduction in overall cleaning frequency. Factors associated with heightened gag reflex included female gender and recent consumption of sweetened or alcoholic beverages, which may increase oral mucosal sensitivity [23]. This barrier can discourage deep cleaning or lead to abandonment of the practice. These findings are consistent with previous research, which has shown heightened oral sensitivity in females (Lipsky *et al.,* 2021), supporting the promotion of gender-specific oral health education [11].

Overall, a multifactorial interplay of demographic factors, perceived benefits, physiological barriers, and familiarity with cleaning tools shapes tongue-cleaning behaviour. Educational interventions should address these domains by integrating tongue hygiene into oral health training curricula, emphasizing proper technique, reducing gag reflex sensitivity, and promoting the use of evidence-based tools [24]. Such initiatives can improve adherence and strengthen the role of medical students as advocates for comprehensive oral hygiene.

5. LIMITATION

This study presents several limitations. Firstly, the cross-sectional design prevents the establishment of causal relationships between behavioural factors and tongue-cleaning practices. Secondly, data were obtained through self-reporting, which may introduce recall bias or social desirability bias, particularly among medical students who are expected to demonstrate ideal health behaviours. Thirdly, the study was conducted at a single medical university, which limits the generalizability of the findings to other institutions or populations. Students from a single university, particularly one with a strong medical curriculum, may not represent the broader population of university students or young adults in Vietnam or other countries. Differences in educational background, cultural norms, socioeconomic status, and access to oral health education may influence tongue-cleaning behaviours in various settings. Lastly, although health behaviour models were applied, some relevant constructs, such as peer influence and wider social norms, were not fully captured and should be addressed in future research.

CONCLUSION

The prevalence of tongue cleaning among medical students remains low, with suboptimal techniques and inappropriate tool usage. Factors, such as gender, overall oral hygiene practices, gag reflex, perceived oral cleanliness, and information-seeking behaviour, were significantly associated with tongue-cleaning habits. These findings underscore the importance of integrating tongue hygiene education into medical training, informed by health behaviour models, to enhance effectiveness and promote long-term practice.

AUTHORS' CONTRIBUTIONS

The authors confirm contribution to the paper as follows: D.D.L., V.M.T., N.D.H., T.L.D.A., T.T.B.D., B.C.K., N.N.L.: Study conception and design; T.L.D.A., T.T.B.D., B.C.K., N.N.L.: Data collection; T.L.D.A., T.T.B.D., B.C.K., N.N.L.: Analysis and interpretation of results; D.D.L., V.M.T., N.D.H., T.L.D.A.: Draft manuscript. All authors reviewed the results and approved the final version of the manuscript.

ETHICS APPROVAL AND CONSENT TO PARTICIPATE

This study was approved by the Institutional Review Board of Hanoi Medical University with the registration No. ĐTSV2024/GCN-HMUIRB.

HUMAN AND ANIMAL RIGHTS

All procedures performed in studies involving human participants were in accordance with the ethical standards of institutional and/or research committee and with the 1975 Declaration of Helsinki, as revised in 2013.

CONSENT FOR PUBLICATION

Written informed consent was obtained from the participants.

STANDARDS OF REPORTING

STROBE guidelines were followed

AVAILABILITY OF DATA AND MATERIALS

All data generated or analyzed during this study are included in this published article.

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CONFLICT OF INTEREST

The authors declare no conflict of interest, financial or otherwise.

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