



Factors Associated with Self-Reported Gingival Bleeding and Dental Anxiety among Male Dental Students in Herat, Afghanistan: A Cross-Sectional Study

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ABSTRACT

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Background and Objective: Periodontal diseases and dental anxiety represent significant global public health challenges, and the personal oral health behaviors of dental students serve as important indicators of the effectiveness of their dental education. This study aimed to evaluate the prevalence of and identify factors associated with self-reported gingival bleeding and dental anxiety among male dental students in the educational environment of Herat.

Method: An institution-based analytical cross-sectional study was conducted among 408 male dental students from three existing dental faculties in Herat city. Participants were selected using a proportionate stratified random sampling approach based on faculty and academic level. Data regarding demographics, oral hygiene behaviors, tobacco use, self-reported gingival bleeding, and dental anxiety (assessed via a single self-reported yes/no question rather than a validated psychometric instrument) were analyzed using descriptive statistics, chi-square tests, and multivariable binary logistic regression models.

Findings/ Result: The overall prevalence of self-reported gingival bleeding during brushing was 21.8%, while dental anxiety was highly prevalent, reported by 38.2% of the students. In the adjusted multivariable analysis, being in the clinical academic stage (aOR = 0.42, 95% CI: 0.24–0.74) and older age (≥ 25 years; aOR = 0.33, 95% CI: 0.12–0.92) were significantly associated with lower odds of self-reported gingival bleeding. Conversely, smokeless tobacco (Naswar or Siti) use was strongly associated with higher odds of gingival bleeding (aOR = 5.51, 95% CI: 2.20–13.81), with users exhibiting more than five times the odds compared to non-users. Not using dental floss (interdental cleaning) was also significantly associated with higher odds of gingival bleeding (aOR = 2.15, 95% CI: 1.18–3.92). For dental anxiety, none of the demographic, behavioral, or tobacco-related variables showed significant associations in the adjusted multivariable model.

Conclusion: The study reveals a concerning high prevalence of both gingival bleeding and dental anxiety among future dental practitioners in Herat. While older age and clinical academic stage were associated with lower odds of gingival bleeding, poor interdental cleaning habits and smokeless tobacco use were associated with higher odds of gingival bleeding. To address these challenges, dental institutions should integrate formal tobacco cessation counseling and strengthen curriculum-based training in interdental oral hygiene.

Keywords: Self-reported gingival bleeding; Dental anxiety; Smokeless tobacco; Naswar; Dental students

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پیش‌بینی‌کننده‌های خون‌ریزی لثه و اضطراب دندان‌دانی در میان محصلان مرد طب دندان در هرات، افغانستان: یک مطالعه مقطعی

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چکیده	اطلاعات مقاله
زمینه و هدف: بیماری‌های پریودنتال و اضطراب دندان‌دانی از چالش‌های مهم بهداشت عمومی در سطح جهان به شمار می‌روند و رفتارهای شخصی محصلان طب دندان در زمینه سلامت دهان، شاخص مهمی برای ارزیابی اثربخشی آموزش دندان‌پزشکی آنان محسوب می‌شود. این مطالعه با هدف بررسی شیوع و شناسایی عوامل مرتبط با خون‌ریزی لثه و اضطراب دندان‌دانی گزارش شده توسط خود محصلان مرد طب دندان در محیط آموزشی شهر هرات انجام شد. روش: یک مطالعه تحلیلی مقطعی مبتنی بر نهاد آموزشی در میان ۴۰۸ محصل مرد طب دندان از سه پوهنځی موجود طب دندان در شهر هرات انجام شد. شرکت‌کنندگان با استفاده از روش نمونه‌گیری تصادفی طبقه‌ای متناسب، بر اساس پوهنځی و مقطع تحصیلی، انتخاب شدند. اطلاعات مربوط به مشخصات جمعیت‌شناختی، رفتارهای بهداشت دهان، مصرف تنباکو، خون‌ریزی لثه گزارش شده توسط خود افراد و اضطراب دندان‌دانی جمع‌آوری و با استفاده از آمار توصیفی، آزمون کای‌دو و مدل‌های رگرسیون لجستیک دوتایی چندمتغیره تحلیل گردید. اضطراب دندان‌دانی با استفاده از یک سؤال واحد خودگزارشی «بلی/خیر» ارزیابی شد و از یک ابزار روان‌سنجی معتبر استفاده نگردید. یافته‌ها: شیوع کلی خون‌ریزی لثه هنگام مسواک‌زدن که توسط محصلان گزارش شده بود، ۲۱.۸٪ بود؛ در حالی که اضطراب دندان‌دانی شیوع بالایی داشت و در ۳۸.۲٪ محصلان گزارش شد. در تحلیل چندمتغیره تعدیل شده، قرار داشتن در مرحله تحصیلی کلینیکی ($aOR = 0.42$، 95% CI: 0.12–0.74) و سن بالاتر (۲۵ سال و بیشتر؛ $aOR = 0.33$، 95% CI: 0.24–0.92) به‌طور معناداری با کاهش احتمال خون‌ریزی لثه گزارش شده توسط خود افراد ارتباط داشت. در مقابل، مصرف تنباکو بدون دود، مانند ناسوار یا سیتی، به‌طور قوی با افزایش احتمال خون‌ریزی لثه ارتباط داشت ($aOR = 5.51$، 95% CI: 2.20–13.81)؛ به‌طوری که	نوع مقاله: پژوهشی صفحات: ۲۴۱–۲۵۸ تاریخ دریافت: ۱۴۰۵ / ۰۳ / ۰۹ تاریخ پذیرش: ۱۴۰۵ / ۰۶ / ۳۱ تاریخ نشر: ۱۴۰۵ / ۰۷ / ۰۱

مصرف کنندگان در مقایسه با افراد غیرمصرف کننده بیش از پنج برابر شانس خونریزی لثه داشتند. استفاده نکردن از نخ دندان (پاک سازی بین دندان ها) نیز به طور معناداری با افزایش احتمال خونریزی لثه مرتبط بود ($aOR = 2.15$, $95\% CI: 1.18-3.92$). در مورد اضطراب دندانی، هیچ یک از متغیرهای جمعیت شناختی، رفتاری یا مرتبط با مصرف تنباکو در مدل چندمتغیره تعدیل شده ارتباط معناداری نشان ندادند.

نتیجه گیری: این مطالعه شیوع نگران کننده بالای هر دو مورد خونریزی لثه و اضطراب دندانی را در میان داکتران آینده رشته طب دندان در هرات نشان می دهد. در حالی که سن بالاتر و قرار داشتن در مرحله تحصیلی کلینیکی با کاهش احتمال خونریزی لثه مرتبط بودند، عادات نامناسب پاک سازی بین دندان ها و مصرف تنباکوی بدون دود با افزایش احتمال خونریزی لثه ارتباط داشتند. برای مقابله با این چالش ها، نهادهای آموزشی طب دندان باید مشاوره رسمی ترک مصرف تنباکو را در برنامه های آموزشی خود ادغام کرده و آموزش مبتنی بر نصاب در زمینه بهداشت بین دندان ها را تقویت کنند.

کلیدواژه ها: خونریزی لثه گزارش شده توسط خود فرد؛ اضطراب دندانی؛ تنباکوی بدون دود؛ نسوار؛ محصلان طب دندان

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1. Introduction

Periodontal diseases, including gingivitis and periodontitis, are among the most prevalent oral diseases worldwide and represent a major public health challenge because of their adverse effects on oral health, systemic health, and quality of life ^[1,2]. Although these conditions are largely preventable through effective oral hygiene practices and regular dental care, they remain highly prevalent because of inadequate oral health literacy, poor oral hygiene behaviors, tobacco use, and limited access to preventive oral healthcare services ^[3]. Dental students, as future oral healthcare providers and public health educators, are expected to promote preventive oral health practices and contribute to the prevention and early management of periodontal diseases and dental anxiety ^[1,4]. Consequently, their own oral health attitudes, behaviors, and self-care practices serve as important indicators of the effectiveness of dental education and professional training ^[5].

Among dental students, self-reported gingival bleeding and dental anxiety represent two distinct yet complementary indicators of oral health. Self-reported gingival bleeding is a commonly used subjective indicator that may reflect underlying gingival inflammation, although it does not constitute a clinical diagnosis of gingivitis or periodontal disease. Dental anxiety, on the other hand, is associated with avoidance of dental care, poorer oral hygiene behaviors, and delayed treatment seeking ^[1,6].

These factors may influence not only students' personal oral health but also their future professional roles, as dental professionals' own behaviors and attitudes can affect clinical performance, patient communication, and preventive care practices. Identifying predictors of gingival bleeding and dental anxiety among dental students can provide valuable insights into behavioral and educational factors, helping institutions develop targeted interventions to improve student well-being, strengthen preventive oral health education, and enhance future dental healthcare delivery.

Tobacco habits are key behavioral factors associated with destructive periodontal disease ^[7]. Naswar and Siti, which are smokeless tobacco (SLT) products, can inflict chemical and mechanical trauma on adjacent oral tissues ^[8,9]. This chemical trauma, combined with the mechanical micro-abrasive friction of Naswar/Siti particulates, has been associated with gingival recession, clinical attachment loss, and gingival bleeding ^[9-11]. The frequency and effectiveness of daily oral hygiene practices are also associated with gingival bleeding, as inadequate toothbrushing and the absence of interdental cleaning facilitate plaque accumulation, which may contribute to gingival inflammation

and an increased likelihood of gingival bleeding ^[12]. Beyond behavioral and local clinical factors, non-modifiable demographic variables such as age ^[13] and sex ^[14], systemic health conditions such as diabetes mellitus ^[15] and psychological stress ^[16] have also been found to be associated with periodontal and gingival diseases.

On the other hand, dental anxiety is an excessive psychological response characterized by fear and distress associated with anticipated or actual dental treatment, affecting approximately 14% of adults worldwide. This often leads to a cycle of treatment avoidance and subsequent oral health neglect ^[17]. Despite professional training in dental procedures, dental students remain susceptible to dental anxiety, which is shaped by negative past clinical experiences and individual psychological factors ^[18]. In dental education, progressive clinical exposure can function as a form of environmental habituation or systematic desensitization ^[19]. This exposure has been associated with lower dental anxiety levels in more experienced students compared to novice preclinical students ^[19,20]. However, this potential desensitization is frequently offset by the intense academic pressures, clinical demands, and personal stressors inherent to dental education, as well as the effects of external environmental stressors, particularly for students studying in conflict-affected regions ^[21,22].

While baseline gingival bleeding and dental anxiety have been evaluated in stable, resource-rich international settings, there is a paucity of such research among dental students in conflict-affected educational environments such as Afghanistan. To address this gap, this institutional cross-sectional study evaluated the prevalence of and identified factors associated with self-reported gingival bleeding and dental anxiety among male dental students across all three existing dental faculties in Herat, Afghanistan.

2. Method

This institution-based analytical cross-sectional study was conducted among approximately 700 currently enrolled dental students in the three existing dental faculties in Herat city, Afghanistan. The study assessed the prevalence of self-reported gingival bleeding and dental anxiety and identified factors associated with these outcomes among the students.

The target population comprised approximately 700 currently enrolled male dental students across the three dental faculties. Because current restrictions on women's university education in Afghanistan prevented access to female dental students ^[23], only male students were eligible for inclusion. The minimum required sample size was calculated using the single-population proportion formula: $n = Z^2 \times p(1-p) / d^2$, where $Z = 1.96$ (95% confidence level), $p = 0.50$ (maximum variability, as no prior prevalence estimate was available for this population), and $d = 0.05$ (margin of error), yielding $n = 384$. Adding a 10% non-response allowance, the target sample was set at 423. Ultimately, 409

students were recruited, representing a response rate of approximately 58.4% of the total eligible population.

For sampling, students were first stratified by faculty (Ghalib University, Herat University, and Hariwa University) and academic level (1st year through internship). The number of participants required from each stratum was determined proportionally based on the number of currently enrolled students in that stratum. Within each stratum, students were randomly selected from the official enrollment lists using. Selected students who were not currently enrolled, were absent during the data-collection period, declined participation, or returned incomplete or invalid questionnaires were excluded from the final analysis.

Self-reported gingival bleeding was assessed by asking participants whether they experienced bleeding from the gums during toothbrushing (yes/no). It should be noted that this self-reported measure does not constitute a clinical diagnosis of gingivitis or periodontal disease. Dental anxiety was assessed using a single binary (yes/no) question asking participants whether they felt anxious or fearful about visiting the dentist. This single-item measure has not been validated against established instruments such as Corah's Dental Anxiety Scale (DAS) or the Modified Dental Anxiety Scale (MDAS), and therefore the precision and comparability of this outcome are limited. This limitation should be considered when interpreting all findings related to dental anxiety.

Data were entered and analyzed using SPSS 27. Descriptive statistics were used to summarize participant characteristics, with categorical variables presented as frequencies and percentages. Bivariate associations between the independent variables (academic stage, age group, cigarette smoking, smokeless tobacco use, and other independent variables like toothbrushing and interdental cleaning and other psychological stresses) and the two binary outcomes (gingival bleeding and dental anxiety) were evaluated using the Pearson chi-square (χ^2) test. To identify factors independently associated with gingival bleeding and dental anxiety, two separate multivariable binary logistic regression models were constructed. The strength of the associations was reported as adjusted odds ratios (aORs) with corresponding 95% confidence intervals. All statistical tests were two-tailed, and a p-value of <0.05 was considered statistically significant.

The study was conducted in accordance with the ethical principles of the Declaration of Helsinki. Participants were informed about the academic purpose of the study and the confidentiality of their responses. Participation was voluntary, and no personally identifying information was used in the analysis.

3. Results

Of the 409 students recruited, one was excluded due to missing data on academic stage, yielding a final analytical sample of 408 students. The majority of the students were in the 20–25 age group (62.7%, n=256), followed by the 15–20 age group (19.4%, n=79) and those aged 25 years or older (17.9%, n=73). Regarding academic stage, 48.8% (n=199) were in the pre-clinical stage (1st and 2nd year), and 51.2% (n=209) were in the clinical stage (3rd year to internship). Among participants with available data, 14.2% (n=58/407) reported smoking, while 7.4% (n=30/406) reported using smokeless tobacco (Naswar). Overall, 21.8% (n=89) of the participants reported experiencing gingival bleeding during brushing. Dental anxiety was reported by 38.2% (n=156) of the students. Regarding oral hygiene behaviors, 42.4% (n=173) reported brushing only once a day, while 57.6% (n=235) brushed two or more times per day. Furthermore, 64.2% (n=262) reported never using dental floss (interdental cleaning), and 78.4% (n=320) did not use mouthwash. Most students (84.6%, n=345) rated their oral health as good or very good. Detailed socio-demographic, clinical, and behavioral characteristics are presented in Table 1.

Table 1: Socio-demographic, clinical and behavioral characteristics of the Study Participants (N=408)*

CHARACTERISTIC	CATEGORY	N (%)
AGE GROUP (YEARS)	15–20	79 (19.4%)
	20–25	256 (62.7%)
	≥25	73 (17.9%)
ACADEMIC STAGE	Pre-clinical (1st & 2nd year)	199 (48.8%)
	Clinical (3rd year–Internship)	209 (51.2%)
SMOKING STATUS	No	349 (85.5%)
	Yes	58 (14.2%)
	Missing	1 (0.2%)
SMOKELESS TOBACCO (NASWAR)	No	376 (92.2%)
	Yes	30 (7.4%)
	Missing	2 (0.5%)
TOOTHBRUSHING FREQUENCY	One time a day	173 (42.4%)
	Two times a day	185 (45.3%)
	More than two times	50 (12.3%)
INTERDENTAL CLEANING (FLOSS)	No	262 (64.2%)

	Yes	146 (35.8%)
MOUTHWASH USE	No	320 (78.4%)
	Yes	88 (21.6%)
SELF-PERCEIVED ORAL HEALTH	Good / Very Good	345 (84.6%)
	Fair / Bad / Not Sure	63 (15.4%)
GINGIVAL BLEEDING	No	319 (78.2%)
	Yes	89 (21.8%)
DENTAL ANXIETY	No	252 (61.8%)
	Yes	156 (38.2%)

* Note: Data are presented as frequencies and percentages. The final analytical sample included 408 participants after excluding one student with missing data for academic stage. Smoking data were available for 407 participants, with one missing response, while smokeless tobacco data were available for 406 participants, with two missing responses. Percentages for smoking and smokeless tobacco are calculated using the total analytical sample (N=408); percentages among non-missing responses are 14.3% (58/407) for smoking and 7.4% (30/406) for smokeless tobacco. Missing data were excluded from the corresponding bivariate analyses.

Gingival bleeding was significantly more prevalent among pre-clinical students (30.2%) compared to clinical students (13.9%) ($X^2 = 14.89$, $p < 0.001$). Furthermore, smokeless tobacco users had a markedly higher prevalence of gingival bleeding (53.3%) compared to non-users (19.1%) ($X^2 = 16.92$, $p < 0.001$). The prevalence of bleeding also showed a statistically significant decreasing trend across age groups ($X^2 = 8.34$, $p = 0.015$). Smoking was associated with a higher prevalence of bleeding (29.3% vs. 20.3%), but this did not reach statistical significance ($X^2 = 1.86$, $p = 0.173$). Notably, behavioral factors were significantly associated with self-reported gingival bleeding. Students who brushed only once a day had a significantly higher prevalence of bleeding (28.9%, 50/173) compared with those who brushed two or more times per day (16.6%, 39/235; $\chi^2 = 8.45$, $p = 0.015$). Similarly, those who did not use dental floss had a significantly higher rate of bleeding (26.0%) compared to floss users (14.4%) ($X^2 = 7.82$, $p = 0.005$). In contrast, dental anxiety was not significantly associated with academic stage, age group, smoking, or smokeless tobacco use (all $p > 0.05$). However, psychological and behavioral perceptions showed marginal associations; students who perceived their oral health as "Fair/Bad/Not Sure" reported a higher prevalence of dental anxiety (46.0%)

compared to those with "Good/Very Good" perceptions (36.2%), though this was only marginally significant ($X^2 = 2.61$, $p = 0.106$). Detailed bivariate associations are presented in Table 2.

CHARACTERISTIC	CATEGORY	N	GINGIVAL BLEEDING, N (%)	X^2	P-VALUE	DENTAL ANXIETY, N (%)	X^2	P-VALUE
TOTAL	Overall	408	89 (21.8)	—	—	156 (38.2)	—	—
ACADEMIC STAGE	Pre-clinical	199	60 (30.2)	14.89	<0.001	70 (35.2)	1.3	0.255
	Clinical	209	29 (13.9)			86 (41.1)		
AGE GROUP	15–20 years	79	25 (31.6)	8.34	0.015	23 (29.1)	5.72	0.057
	20–25 years	256	55 (21.5)			109 (42.6)		
	≥25 years	73	9 (12.3)			24 (32.9)		
SMOKING*	No	349	71 (20.3)	1.86	0.173	136 (39.0)	0.61	0.435
	Yes	58	17 (29.3)			19 (32.8)		
SMOKELESS TOBACCO.*	No	376	72 (19.1)	16.92	<0.001	145 (38.6)	0	1
	Yes	30	16 (53.3)			11 (36.7)		
BRUSHING FREQ.	One time	173	50 (28.9)	8.45	0.015	70 (40.5)	1.12	0.572
	Two times	185	31 (16.8)			68 (36.8)		
	> Two times	50	8 (16.0)			18 (36.0)		
FLOSSING	No	262	68 (26.0)	7.82	0.005	104 (39.7)	0.45	0.502
	Yes	146	21 (14.4)			52 (35.6)		
MOUTHWASH	No	320	73 (22.8)	1.15	0.283	125 (39.1)	0.32	0.571
	Yes	88	16 (18.2)			31 (35.2)		
SELF-PERCEIVED HEALTH	Good/Very Good	345	71 (20.6)	1.24	0.265	125 (36.2)	2.61	0.106
	Fair/Bad/Not Sure	63	18 (28.6)			29 (46.0)		

Table 2: Bivariate Analysis of Gingival Bleeding and Dental Anxiety by Participant Characteristics

*Note: The sample size for the smoking analysis was $N = 407$ because one response was missing, and the sample size for the smokeless tobacco analysis was $N = 406$ because two responses were missing. Missing data were handled by pairwise exclusion for the respective analyses.

In the multivariable logistic regression analysis for gingival bleeding as presented in details in Table 3, after adjusting for age group, smoking, smokeless tobacco use, toothbrushing frequency, and flossing, being in the clinical stage was independently associated with significantly lower odds of experiencing gingival bleeding compared to the pre-clinical stage (aOR = 0.42, 95% CI: 0.24–0.74, $p = 0.003$). Furthermore, students aged 25 years and older had significantly lower odds of gingival bleeding (aOR = 0.33, 95% CI: 0.12–0.92, $p = 0.034$). Importantly, smokeless tobacco use remained strongly associated with higher odds of gingival bleeding after adjustment for all other variables (aOR = 5.51, 95% CI: 2.20–13.81, $p < 0.001$). Regarding behavioral factors, not using dental floss was independently associated with higher odds of gingival bleeding (aOR = 2.15, 95% CI: 1.18–3.92, $p = 0.012$). Additionally, brushing only once a day showed a trend toward higher odds of bleeding compared to brushing two or more times, though it was marginally significant (aOR = 1.68, 95% CI: 0.98–2.88, $p = 0.058$). Smoking status was not significantly associated with gingival bleeding in the adjusted model ($p = 0.892$).

Table 3: Multivariable Logistic Regression Predicting Gingival Bleeding (N=406) *

Variable	Adjusted Odds Ratio (aOR)	95% Confidence Interval (CI)	p-value
Academic Stage (Ref: Pre-clinical)			
Clinical	0.42	0.24 – 0.74	0.003
Age Group (Ref: 15–20 years)			
20–25 years	0.75	0.40 – 1.41	0.372
25+ years	0.33	0.12 – 0.92	0.034
Smoking (Ref: No)			
Yes	1.04	0.48 – 2.26	0.921
Smokeless Tobacco (Ref: No)			
Yes	5.51	2.20 – 13.81	<0.001
Toothbrushing Frequency. (Ref: ≥ 2 times)			
One time	1.68	0.98 – 2.88	0.058
Interdental Cleaning (Ref: Yes)			
No	2.15	1.18 – 3.92	0.012

*Note: N=406 due to listwise exclusion of participants with missing data for smoking or smokeless tobacco variables. The model is adjusted for all variables listed in the table.

For dental anxiety, none of the demographic, behavioral, or tobacco-related independent variables were significantly associated with dental anxiety after adjustment. Clinical students had slightly higher, though non-significant, odds of dental anxiety compared to pre-clinical students (aOR = 1.22, 95% CI: 0.77–1.94, $p = 0.391$). Self-perceived oral health status also did not reach statistical significance in the adjusted model (aOR = 1.45, 95% CI: 0.78–2.70, $p = 0.241$), as presented in the table 4.

Table 4: Multivariable Logistic Regression Predicting Dental Anxiety (N=406)*

Variable	Adjusted Ratio (aOR)	Odds	95% Confidence Interval (CI)	p-value
Academic Stage (Ref: Pre-clinical)				
Clinical	1.22		0.77 – 1.94	0.391
Age Group (Ref: 15–20 years)				
20–25 years	1.58		0.86 – 2.91	0.142
25+ years	0.95		0.43 – 2.10	0.898
Smoking (Ref: No)				
Yes	0.74		0.39 – 1.41	0.362
Smokeless Tobacco (Ref: No)				
Yes	0.88		0.37 – 2.08	0.771
Toothbrushing Frequency. (Ref: ≥ 2 times)				
One time	1.06		0.66 – 1.71	0.815
Interdental Cleaning (Ref: Yes)				
No	1.15		0.63 – 2.10	0.64
Self-Perceived Health (Ref: Good/Very Good)				
Fair/Bad/Not Sure	1.45		0.78 – 2.70	0.241

*Note: N=406 due to listwise exclusion of participants with missing data for smoking or smokeless tobacco variables. The model is adjusted for all variables listed in the table.

4. Discussion

The primary objective of this investigation was to evaluate the prevalence of and factors associated with self-reported gingival bleeding, dental anxiety, and oral hygiene behaviors among male dental students. Overall, nearly one-fifth of the analytical sample (21.8%) reported experiencing gingival bleeding during

toothbrushing, while over one-third (38.2%) reported experiencing dental anxiety. Multivariable analysis demonstrated that smokeless tobacco (Naswar) use and lack of interdental cleaning were significantly associated with higher odds of gingival bleeding. Conversely, being in the clinical academic stage and older age (≥ 25 years) were significantly associated with lower odds of gingival bleeding.

The overall prevalence of self-reported gingival bleeding (21.8%) suggests a notable frequency of this symptom among future dental professionals. This aligns with the global challenge of oral diseases, where gingival conditions remain highly prevalent worldwide despite educational advancements^[24]. Regarding academic stage, our study found that pre-clinical students had significantly higher odds of gingival bleeding compared to their clinical counterparts (aOR = 0.42, 95% CI: 0.24–0.74 for clinical students). This association may be partly explained by the greater exposure of clinical-stage students to preventive dentistry, periodontal diagnosis, patient communication, and the consequences of poor self-care, which could foster improved oral health behaviors^[25-27]. However, because this is a cross-sectional study, it is not possible to determine whether clinical training itself led to improved oral hygiene or whether students with better oral health behaviors are more likely to progress to the clinical stage. Longitudinal studies are needed to clarify the temporal direction of this association.

Age was also significantly associated with gingival bleeding in the present study. Students aged ≥ 25 years exhibited the lowest odds of gingival bleeding. This association may reflect the cumulative effect of dental education, greater clinical experience, and the progressive adoption of appropriate oral hygiene practices^[28,29]; however, given the cross-sectional design, this finding should be interpreted as an association rather than evidence that aging or prolonged education directly reduces gingival bleeding.

Regarding smokeless tobacco, our study found a strong association between its use and self-reported gingival bleeding, with users having over five times the odds of reporting bleeding compared to non-users (aOR = 5.51, 95% CI: 2.20–13.81). The use of Naswar (the most commonly available smokeless tobacco product) is a deeply rooted cultural practice in Afghanistan, yet its potential adverse effects on periodontal health are often underestimated. Previous studies have reported the detrimental impact of poor oral health behaviors, including tobacco use, among health-professions students, noting that despite their medical knowledge, harmful practices may compromise oral health^[5].

Despite being situated within a university environment, overall compliance with recommended oral hygiene habits was concerningly low among participants. The majority of students reported never flossing (64.2%), while 42.4% brushed their teeth only once per day. The multivariable regression confirmed that not flossing was independently associated with higher odds of

self-reported gingival bleeding, more than doubling the odds (aOR = 2.15, 95% CI: 1.18–3.92, $p = 0.012$). Toothbrushing alone primarily cleans the buccal, lingual, and occlusal surfaces, leaving interproximal areas more susceptible to biofilm accumulation. This localized stagnation may promote microbial dysbiosis and contribute to inflammatory changes in the interdental gingival tissues, although such mechanisms cannot be confirmed by self-reported data alone^[30]. These findings reinforce the conclusions of a systematic review^[31], which confirmed that combining interdental cleaning habits with daily toothbrushing yields significantly greater reductions in gingival inflammation and bleeding than toothbrushing alone.

Dental anxiety was highly prevalent among the participants (38.2%), which is a concerning finding given that these individuals are dental students who will be managing anxious patients in their future careers. However, this high prevalence might be attributed to a limitation in our assessment method; we evaluated dental anxiety using a single binary (yes/no) question rather than established instruments like Corah's Dental Anxiety Scale or its modified versions, which may have compromised the precision of our measurements^[32,33]. This measurement limitation is important to consider, as prior literature suggests that dental students generally exhibit lower levels of dental anxiety compared to their non-dental peers, largely due to early clinical exposure and education^[19]. Nevertheless, it cannot be argued that dental anxiety is completely absent among dental students. Other studies support that the issue remains common within this demographic, with students frequently experiencing moderate levels of anxiety^[18]. Previous longitudinal evidence suggests that dental anxiety tends to decrease as students progress from introductory classes to the final years of study, potentially as they accumulate academic knowledge and practical clinical experience^[33,34]. Furthermore, our study found that dental anxiety was not significantly associated with academic stage, age, smoking, or smokeless tobacco use. This specific finding should be interpreted with caution due to the aforementioned methodological limitations. This lack of statistical significance directly contrasts with the findings of previous studies^[33,34], which demonstrated that dental anxiety typically decreases over time as students transition from introductory classes to final-year clinical settings. We attribute this discrepancy to measurement sensitivity: while the cited studies successfully detected these associations by utilizing validated, comprehensive psychometric scales, our single-question approach may have lacked the depth necessary to capture these subtle demographic and academic variations. Nevertheless, it remains clear that dental anxiety is a common problem within this demographic, with students frequently experiencing it at a moderate level^[18].

This study has several limitations, including its cross-sectional design, which precludes the establishment of causal or temporal relationships between the

identified associated factors and oral health outcomes, reliance on self-reported data instead of objective clinical measures that can introduce potential recall bias and social desirability bias, and an all-male sample necessitated by current restrictions on women's education in Afghanistan. Additionally, dental anxiety was assessed using a single binary question rather than a validated psychometric scale, which likely reduced measurement sensitivity. Despite these constraints, the study offers two key insights. First, the strong association between smokeless tobacco (Naswar) use and gingival bleeding indicates that academic dental knowledge alone does not deter deeply rooted cultural practices. This highlights a need to integrate formal tobacco cessation counseling into dental curricula, particularly targeting younger, pre-clinical students who exhibit higher rates of periodontal symptoms. Second, the high prevalence of dental anxiety among future practitioners underscores the need for institutions to introduce stress-management frameworks and mental health support to better prepare students for their clinical careers, while also strengthening curriculum-based training in interdental oral hygiene.

The study reveals a concerning high prevalence of both gingival bleeding and dental anxiety among future dental practitioners in Herat. While older age and clinical academic stage were associated with lower odds of gingival bleeding, poor interdental cleaning habits and the use of smokeless tobacco were associated with higher odds of gingival bleeding. To address these challenges, dental institutions should integrate formal tobacco cessation counseling and strengthen curriculum-based training in interdental oral hygiene.

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Ethics approval

The study obtained ethical approval from the Ethics Committee of Ghalib University, Herat, Afghanistan (Ethics Approval No. [Afg-Gh.U.H-R.E.C.2026-0048]). Participation was entirely voluntary, and informed consent was obtained from all participants. Confidentiality and anonymity were strictly ensured

throughout the study, and the collected data were used solely for research purposes.

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