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Association of health-promoting behaviors with oral health status among Turkish dental students: a cross-sectional study

Beyza Ballı Akgöl¹, Merve Bayram², Nilüfer Üstün³ and Nurcan Aksaka^{4*}

Abstract

Background Oral health is an essential component of overall well-being, and dentistry students are expected to model healthy behaviors. However, their lifestyle habits may not always reflect this role. This study explores the relationship between oral health status and health-promoting behaviors among fourth-year dental students. While the Health-Promoting Lifestyle Profile II (HPLP II) has been widely applied, its use alongside objective oral health indices in this population remains limited.

Methods This cross-sectional study assessed health-promoting behaviors using the Health-Promoting Lifestyle Profile II (HPLP II) and evaluated oral health status using clinical indices, including Decayed, Missing, and Filled Teeth (DMFT) index, Gingival Index (GI), and Plaque Index (PI), among fourth-year dental students.

Results Students with better gingival health exhibited higher overall health-promoting lifestyle scores, particularly in the domains of nutrition and health responsibility. Similarly, participants with better plaque control demonstrated more favorable stress management behaviors. In addition, weak inverse associations were observed between dental caries experience and spiritual growth, as well as between plaque accumulation and overall health-promoting lifestyle behaviors.

Conclusion This study revealed significant links between key health-promoting lifestyle domains—nutrition, stress management, and health responsibility—and oral health indicators. These findings underscore the need to integrate structured health promotion modules into dental curricula to improve students' well-being and clinical competence.

Keywords Health-promoting lifestyle profile II, Oral health, Plaque index, Gingival index, Dental students

*Correspondence:

Nurcan Aksaka
naltas@medipol.edu.tr

¹Department of Pediatric Dentistry, School of Dentistry, Antalya Bilim University, Antalya, Turkey

²Department of Pediatric Dentistry, School of Dentistry, Istanbul Medipol University, Istanbul, Turkey

³Department of Pediatric Dentistry, Faculty of Dentistry, Istanbul Health and Technology University, Istanbul, Turkey

⁴Department of Periodontology, School of Dentistry, Istanbul Medipol University, TEM Avrupa Otoyolu Göztepe Çıkışı. No.1, Bağcılar, Istanbul 34214, Turkey



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Introduction

Oral health is an essential component of overall well-being and is intrinsically linked to systemic health. Numerous studies have established associations between oral diseases and systemic conditions such as diabetes mellitus, cardiovascular diseases, and adverse pregnancy outcomes [1–5]. Oral pathologies may contribute to systemic inflammation, while systemic disorders often present with oral manifestations. Despite its significance, oral health care is frequently neglected, and oral diseases remain among the most prevalent global health problems [6, 7].

Dental students, by virtue of their education and awareness of oral disease risk factors, are expected to model positive health behaviors and contribute to public oral health initiatives [8, 9]. However, university life often marks a transition to independent living, introducing personal and academic stressors that increase susceptibility to unhealthy behaviors [10, 11].

Health behaviors adopted in young adulthood are known to influence long-term health outcomes [12]. In Turkey, university students constitute a substantial portion of the young adult population, which makes this group particularly important for studies on health-related behaviors [13]. However, studies indicate that this demographic is particularly vulnerable to poor nutrition, insufficient physical activity, and stress-related issues [14–16]. Because lifestyle behaviors developed during university often persist into adulthood, understanding and influencing these behaviors is critical for long-term health promotion [17].

The Health-Promoting Lifestyle Profile II (HPLP II), developed by Walker et al., is a widely used instrument for evaluating health-promoting behaviors across six domains: health responsibility, physical activity, nutrition, stress management, spiritual growth, and interpersonal relationships [18, 19].

Studies have frequently applied the HPLP II in various populations [17, 18, 20–24] and reported moderate levels of health-promoting behaviors, with interpersonal relationships and spiritual growth scoring highest and physical activity and health responsibility scoring lowest [17, 18, 20, 24].

While prior studies have examined behavioral profiles using HPLP II, few have explored how these self-reported behaviors relate to objective oral health outcomes [25, 26]. Only one known study to date has combined HPLP II with clinical oral health data, using plaque indices (Quigley-Hein and Approximal Plaque Index) to assess associations between health responsibility and oral hygiene among dental students [26]. However, Armencia et al., did not include broader clinical markers such as the Decayed, Missing, and Filled Teeth (DMFT) index, Gingival Index (GI), and Plaque Index (PI).

To the best of our knowledge, this is one of the first studies to integrate the HPLP II with all three clinical oral health indices—DMFT, GI, and PI—to examine the behavioral-clinical relationship in dental students. Fourth-year students were selected for this investigation, as they have completed most of their theoretical and preclinical education, making them an ideal group for assessing how health-promoting behaviors may translate into clinical oral health outcomes. At this stage of dental education, students begin regular patient care and apply their theoretical knowledge in clinical settings, which requires the adoption of consistent professional and personal health behaviors. Their exposure to clinical environments also enhances awareness of infection control, stress management, and patient communication—all factors closely related to health-promoting lifestyle domains. This integrative approach enables a more comprehensive understanding of the interplay between lifestyle choices and measurable oral health status in a key professional population.

The present study addresses a critical gap by combining a validated behavioral assessment tool with objective clinical indices, thereby offering a more holistic understanding of the relationship between lifestyle and oral health in a key target group—fourth-year dental students who are on the cusp of entering professional practice.

Fourth-year dental students were deliberately selected for this study because they have completed most of their theoretical and preclinical education and have begun regular clinical practice. At this stage, students are expected to apply preventive and health-promoting principles not only in patient care but also in their own daily lives. Their clinical responsibilities, increased awareness of oral-systemic health relationships, and exposure to patient-centered care make them a particularly relevant group for examining the association between health-promoting lifestyle behaviors and objective oral health outcomes.

To clarify the conceptual basis of the study, Fig. 1 presents the hypothesized relationship between health-promoting lifestyle domains and oral health indicators. It is assumed that higher scores in domains such as nutrition, stress management, physical activity, and health responsibility correspond to improved plaque control, better gingival health, and reduced caries experience.

Although various studies have assessed health-promoting behaviors among healthcare students using the HPLP II, only one study has specifically examined its relationship with clinical oral health indices among dental students [26]. Therefore, the present study contributes to this limited body of evidence by exploring behavioral-clinical associations in a comparable population.

This study aims to explore the association between health-promoting lifestyle behaviors and clinical oral health status among fourth-year dental students in

Conceptual Framework Linking Health-Promoting Behaviors to Oral Health Outcomes

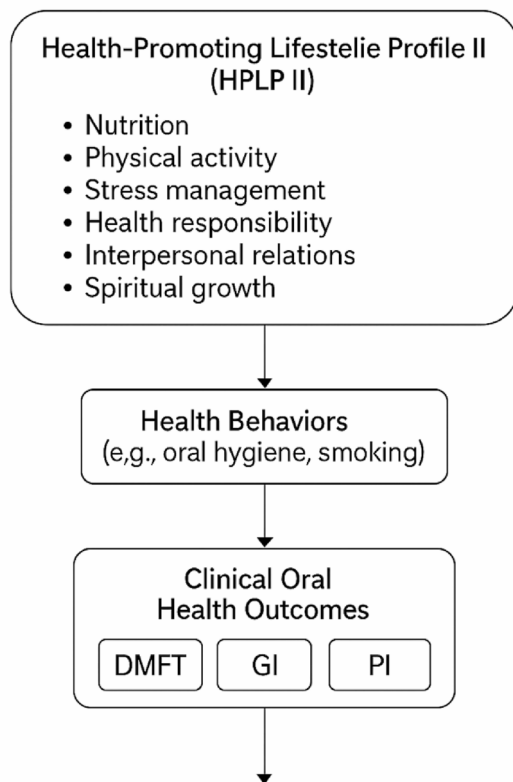


Fig. 1 Conceptual Framework Linking Health-Promoting Behaviors to Oral Health Outcomes. The diagram illustrates the hypothesized associations between six lifestyle domains of the HPLP II and oral health outcomes (DMFT, GI, PI)

Turkey. By employing the HPLP II alongside objective oral health measures (DMFT, GI, and PI), we examine whether lifestyle behaviors are predictive of oral hygiene and periodontal outcomes.

We hypothesize that higher levels of health-promoting lifestyle behaviors are associated with better clinical oral health outcomes, as measured by DMFT, GI, and PI indices.

Materials and methods

Ethical considerations

The study protocol was reviewed and approved by the Ethics Committee of Istanbul Medipol University (Approval Number: E-10840098-772.02-2948). Written informed consent was obtained from all participants before data collection. Participants were thoroughly informed about the study's purpose, procedures, and rights, including the option to withdraw at any stage without any consequences. The research was conducted per the ethical principles of the Declaration of Helsinki.

Participants and sample size

This cross-sectional study was conducted among fourth-year students enrolled in the School of Dentistry at Istanbul Medipol University. Based on the total eligible population of 208 students, the minimum required sample size was calculated assuming a 50% expected prevalence, a 95% confidence level ($\alpha = 0.05$), and a margin of error of $\pm 5\%$, yielding a target of 135 participants. Nevertheless, all 208 eligible students were invited to participate to ensure comprehensive coverage of the target group and minimize sampling bias. Six students either declined participation or did not meet the inclusion criteria, resulting in a final sample of 202 participants (response rate $\approx 97\%$).

Inclusion and exclusion criteria

Inclusion criteria comprised: being systemically healthy, not using any medication, and having a minimum of 20 natural teeth. Exclusion criteria included: undergoing active orthodontic treatment, experiencing oral pain or infections that impeded effective oral hygiene, pregnancy, lactation, and refusal to provide informed consent. Six students were excluded from the study—five due to systemic illness or medication use, and one due to incomplete questionnaire responses.

Study design

The study was conducted in two phases: A questionnaire-based survey and a clinical oral examination.

In the first phase, participants completed a structured questionnaire collecting demographic data and information on self-reported oral health practices, including tooth brushing frequency, use of dental floss, use of mouthwash or mouth spray, current smoking condition, and regular dental visits. These included:

- Tooth brushing frequency
scored as: ≥ 2 times/day = 2 (Regular);
once/day = 1 or $< \text{once/day}$ = 0 (Irregular)
- Use of dental floss
Yes = 1; No = 0
- Use of mouthwash/mouth spray
Yes = 1; No = 0
- Current smoking
Yes = 1; No = 0
- Frequency of dental visits
Regular (at least once every 6 to 12 months) = 1;
Irregular (less than once per year or only in case of complaints/emergencies) = 0

Data regarding participants' socioeconomic background and stress levels—which could influence both behaviors and oral health—was not collected. Participants then completed the Turkish version of the Health-Promoting

Lifestyle Profile II (HPLP II) questionnaire. Originally developed by Walker et al. [19], this tool includes 52 items across six subscales (health responsibility, spiritual growth, physical activity, interpersonal relationships, nutrition, and stress management), each rated on a 4-point Likert scale from 1 (never) to 4 (routinely). Total scores ranged from 52 to 208 and were categorized as:

- Poor (52–90)
- Moderate (91–129)
- Good (130–168)
- Excellent (169–208)

Participants completed the questionnaire at their convenience, typically in a quiet and familiar environment such as their home or a university setting. As the survey was administered through Google Forms, responses were self-reported and collected without direct supervision, which may have introduced response bias or reduced control over the survey environment.

The Turkish version used in this study was validated by Pınar et al. [27], who confirmed its construct validity, internal consistency (Cronbach's $\alpha = 0.89$), and factor structure through confirmatory factor analysis, ensuring its suitability for use in Turkish populations.

In the second phase, clinical oral health assessments were performed to measure the DMFT index based on WHO quantification [28], the GI based on Löe & Silness [29], and the PI based on Silness & Löe [30]. All clinical examinations were conducted by a single calibrated examiner (N.A.), a periodontist with eight years of clinical experience. To ensure reliability, intra-examiner agreement was tested on a subsample of 20 students, with re-assessments performed one week apart. All clinical examinations were performed by a single calibrated examiner. Therefore, intra-examiner calibration was not applicable. To ensure intra-examiner reliability, repeated assessments were conducted on 10% of the participants before the main data collection, yielding consistent results. The intra-class correlation coefficients (ICCs) for DMFT, GI, and PI were 0.91, 0.87, and 0.89 respectively, indicating high reliability. Inter-examiner reliability was not applicable, as all assessments were performed by a single examiner. All data from the questionnaire and clinical assessments were entered independently by two researchers (B.B.A., N.Ü.) into SPSS software. After data entry, the datasets were cross-verified for accuracy and consistency. Any discrepancies were resolved through mutual review. Outliers, implausible values, and missing entries were examined and corrected when necessary before statistical analysis. This double-entry and verification approach helped ensure data integrity and minimize potential bias.

Third molars were excluded from the analysis, not only due to their variable eruption patterns but also in accordance with global epidemiological standards. Exclusion of third molars is a widely accepted approach in oral health research, as it ensures consistency and comparability across different populations and studies. GI and PI were assessed at four sites per tooth—mesio Buccal, mid Buccal, disto Buccal, and mid Lingual—using a Williams periodontal probe. For each participant, mean DMFT, GI and PI values were calculated.

The categorization criteria for oral health indices were as follows:

1. DMFT Index
 - Extremely Low: 0.0 – 1.1
 - Low: 1.2 – 2.6
 - Standard: 2.7 – 4.4
 - High: 4.5 – 6.5
 - Extremely High: > 6.6
2. GI
 - Mild Inflammation: 0.1 – 1.0
 - Moderate Inflammation: 1.1 – 2.0
 - Severe Inflammation: 2.1 – 3.0
3. PI
 - Good Oral Hygiene: 0.0 – 0.9
 - Fair Oral Hygiene: 1.0 – 1.9
 - Poor Oral Hygiene: 2.0 – 3.0

Statistical analysis

Statistical analysis was performed using IBM SPSS Statistics version 22 (IBM Corp., Armonk, NY, USA). Normality of the data distribution was assessed using the Kolmogorov-Smirnov test. Descriptive statistics, including mean, standard deviation, median, minimum, and maximum values, were calculated for continuous variables, while categorical variables were summarized using frequencies and percentages.

For comparisons across groups, one-way analysis of variance (ANOVA) was used for normally distributed continuous variables, while Student's t-test was employed for pairwise group comparisons. In cases where variables were not normally distributed, the Mann-Whitney U test was used. Associations between categorical variables (e.g., gender and smoking status, or toothbrushing frequency and dental visit regularity) were analyzed using the Chi-square test. Pearson's correlation coefficient was applied to evaluate the strength and direction of linear relationships among continuous variables. The internal consistency of the HPLP II questionnaire was assessed

Table 1 Self-Reported oral health practices among Fourth-Year dental students ($n=202$)

| | | <i>n</i> | % | <i>p</i> |
|-----------------------------------|-----------------------|----------|------|---------------|
| Demographics | | | | |
| Gender | Female | 103 | 51 | 0.778 |
| | Male | 99 | 49 | |
| Behavioral factors | | | | |
| Smoking | Yes | 68 | 33.7 | 0.001* |
| | No | 134 | 66.3 | |
| Toothbrushing frequency | Regular | 164 | 81.2 | 0.001* |
| | Irregular | 38 | 18.8 | |
| Use of dental floss | Yes | 140 | 69.3 | 0.001* |
| | No | 62 | 30.7 | |
| Use of mouthwash/mouth spray | Yes | 107 | 53 | 0.398 |
| | No | 95 | 47 | |
| Frequency of visiting the dentist | Regular | 103 | 51 | 0.778 |
| | Irregular | 99 | 49 | |
| Oral Health Indicators | | | | |
| DMFT | Extremely low | 29 | 14.4 | 0.001* |
| | Low | 19 | 9.4 | |
| | Standard | 39 | 19.3 | |
| | High | 42 | 20.8 | |
| | Extremely high | 73 | 36.1 | |
| GI | Mild inflammation | 114 | 56.4 | 0.067 |
| | Moderate inflammation | 88 | 43.6 | |
| PI | Good oral hygiene | 169 | 83.7 | 0.001* |
| | Fair oral hygiene | 33 | 16.3 | |

Regular brushing: ≥ 2 times/day; Irregular: ≤ 1 time/day. Regular dental visits: once every 6–12 months. Floss/mouthwash use: self-reported Yes/No

DMFT Decayed, Missing, and Filled Teeth, GI Gingival Index, PI Plaque Index

This table presents the distribution of demographic and behavioral characteristics among participants, including gender, smoking status, oral hygiene behaviors, and clinical oral health indices (DMFT, GI, PI)

Chi-square test * $p < 0.05$

using Cronbach's alpha. A two-tailed p -value < 0.05 was considered statistically significant throughout the analyses. All participants included in the final analysis had complete data; therefore, no imputation or statistical handling of missing data was required. Multiple comparison corrections such as the Bonferroni adjustment were not applied because only one variable (DMFT index) was analyzed across multiple categories, and no statistically significant group differences were observed. Therefore, correction procedures were considered unnecessary. The statistical tests were primarily exploratory, aiming to identify preliminary associations between behavioral and clinical variables rather than confirmatory hypothesis testing.

Assessment of potential confounders

Although factors such as socioeconomic status, academic stress, and dietary frequency may influence health-related behaviors and oral health outcomes, these variables were not directly assessed in the present study. This

Table 2 Descriptive statistics and internal consistency for Health-Promoting lifestyle profile II (HPLP II) subscale scores ($n=202$)

| | Minimum | Maximum | Mean \pm SD | Cronbach's alpha |
|----------------------------|---------|---------|--------------------|------------------|
| Health | 14 | 36 | 22.78 \pm 4.48 | 0.767 |
| Responsibility | | | | |
| Physical Activity | 8 | 32 | 18.39 \pm 4.90 | 0.824 |
| Nutrition | 11 | 33 | 21.99 \pm 3.82 | 0.577 |
| Spiritual Growth | 16 | 36 | 26.51 \pm 4.57 | 0.784 |
| Interpersonal Relationship | 16 | 36 | 26.46 \pm 3.88 | 0.696 |
| Stress Management | 9 | 32 | 19.17 \pm 3.63 | 0.620 |
| Total HPLP II score | 94 | 198 | 135.28 \pm 17.43 | 0.891 |

Mean \pm SD Mean score and standard deviation, Cronbach's α internal consistency coefficient for each subscale, HPLP II Health-Promoting Lifestyle Profile II

This table displays the mean, standard deviation, and Cronbach's alpha values for each HPLP II subscale, demonstrating internal consistency reliability

omission is acknowledged as a limitation and was considered when interpreting the findings.

Results

Participant characteristics

The results show that complete data were obtained from 202 fourth-year dental students, comprising 103 females (51%) and 99 males (49%), aged 21 to 31 years (mean = 23.35 ± 1.38).

Demographic characteristics and oral health behaviors

The demographic characteristics and oral health behaviors were summarized in Table 1. Among the participants, 66.3% were non-smokers and 33.7% were smokers. Most students (81.2%) reported regular toothbrushing, while 18.8% brushed irregularly. 69% reported using dental floss.

Clinical oral health indices

Regarding clinical indices (Table 1), the DMFT scores ranged from 0 to 18, with a mean of 5.74 ± 4.18 and a median of 5. There was a statistically significant distribution across DMFT categories ($p = 0.001$). There were no significant differences between GI categories ($p > 0.05$). However, a significantly higher proportion of students had good plaque index scores (83.7%) compared to those with poor scores (16.3%) ($p = 0.001$).

Health-promoting lifestyle profile II (HPLP II) scores

Descriptive statistics for the HPLP II subscale scores were presented in Table 2. The total HPLP II scores ranged from 94 to 198, with a mean of 135.28 ± 17.43 . The internal consistency of the HPLP II scale, assessed using Cronbach's alpha, was high ($\alpha = 0.891$), indicating good reliability. Based on total scores, 79 students (39.1%) exhibited a moderate level of health-promoting

behaviors, 118 students (58.4%) demonstrated good levels, and five students (2.5%) achieved excellent scores.

Associations between HPLP II and demographic or behavioral factors

Table 3 presents the relationship between health-promoting lifestyle behaviors (as measured by HPLP II subscale scores) and various factors, including demographic characteristics (e.g., gender), behavioral factors (e.g., smoking status, tooth brushing frequency, use of dental floss, use of mouthwash, and dental visit frequency). Male students exhibited significantly higher physical activity scores than females ($p=0.003$, Cohen's $d=0.417$), indicating a moderate effect size.

Non-smokers demonstrated significantly higher nutrition scores than smokers ($p=0.015$, Cohen's $d=0.371$), reflecting a small-to-moderate effect. Students who used dental floss had significantly higher health responsibility scores than those who did not ($p=0.048$, Cohen's $d=0.297$), representing a small effect size.

Associations between HPLP II scores and clinical oral health indices

Table 4 presents the relationship between HPLP II scores and clinical oral health status. Students with mild gingival inflammation demonstrated significantly higher mean scores in the health responsibility ($p=0.008$, Cohen's $d=0.380$), nutrition ($p=0.046$, Cohen's $d=0.287$), and total HPLP II scores ($p=0.031$, Cohen's $d=0.308$) compared to those with moderate gingival index levels, representing small to moderate effect sizes. Participants with better plaque index levels had significantly higher stress management scores than those with moderate plaque levels ($p=0.005$, Cohen's $d=0.464$), representing a moderate effect size.

Correlation analysis

The results of the correlation analysis between clinical indices and HPLP II scores were shown in Table 5. A weak inverse correlation appeared between the DMFT index and the spiritual growth subscale ($r=-0.153$, $p=0.030$). Additionally, weak negative correlations were

Table 3 Associations between HPLP II subscale scores and participant Demographics, and behavioral factors

| | | Health responsibility | Physical Activity | Nutrition | Spiritual Growth | Interpersonal Relationship | Stress Management | HPLP II |
|-----------------------------------|------------------|-----------------------|-------------------|------------------|------------------|----------------------------|-------------------|--------------------|
| | | Mean \pm SD | Mean \pm SD | Mean \pm SD | Mean \pm SD | Mean \pm SD | Mean \pm SD | Mean \pm SD |
| Demographics | | | | | | | | |
| Gender | Female | 22.53 \pm 4.32 | 17.4 \pm 4.05 | 22.21 \pm 3.8 | 26.7 \pm 4.38 | 26.96 \pm 3.83 | 19.28 \pm 3.97 | 135.09 \pm 16.04 |
| | Male | 23.03 \pm 4.66 | 19.41 \pm 5.49 | 21.75 \pm 3.86 | 26.3 \pm 4.78 | 25.93 \pm 3.88 | 19.05 \pm 3.25 | 135.47 \pm 18.85 |
| | <i>p</i> | 0.433 | 0.003* | 0.388 | 0.540 | 0.059 | 0.651 | 0.875 |
| | <i>Cohen's d</i> | 0.111 | 0.417 | 0.120 | 0.087 | 0.267 | 0.063 | 0.022 |
| Behavioral factors | | | | | | | | |
| Smoking | Yes | 22.63 \pm 4.68 | 18.19 \pm 5.06 | 21.07 \pm 3.52 | 26.31 \pm 4.57 | 26.38 \pm 3.87 | 19.21 \pm 3.71 | 133.79 \pm 18.19 |
| | No | 22.85 \pm 4.4 | 18.49 \pm 4.84 | 22.45 \pm 3.9 | 26.6 \pm 4.59 | 26.49 \pm 3.9 | 19.15 \pm 3.6 | 136.03 \pm 17.05 |
| | <i>p</i> | 0.745 | 0.688 | 0.015* | 0.665 | 0.849 | 0.917 | 0.390 |
| | <i>Cohen's d</i> | 0.048 | 0.060 | 0.371 | 0.063 | 0.028 | 0.016 | 0.127 |
| Toothbrushing frequency | Regular | 22.97 \pm 4.55 | 18.3 \pm 4.85 | 21.95 \pm 3.84 | 26.45 \pm 4.43 | 26.54 \pm 3.8 | 19.16 \pm 3.73 | 135.37 \pm 17.57 |
| | Irregular | 21.95 \pm 4.17 | 18.76 \pm 5.17 | 22.13 \pm 3.79 | 26.74 \pm 5.18 | 26.08 \pm 4.23 | 19.21 \pm 3.2 | 134.87 \pm 17.02 |
| | <i>p</i> | 0.206 | 0.600 | 0.794 | 0.729 | 0.508 | 0.937 | 0.873 |
| | <i>Cohen's d</i> | 0.234 | 0.092 | 0.047 | 0.060 | 0.114 | 0.014 | 0.029 |
| Use of dental floss | Yes | 23.19 \pm 4.32 | 18.39 \pm 4.72 | 22.19 \pm 3.7 | 26.56 \pm 4.59 | 26.57 \pm 3.91 | 19.36 \pm 3.64 | 136.25 \pm 16.77 |
| | No | 21.84 \pm 4.75 | 18.39 \pm 5.33 | 21.53 \pm 4.08 | 26.39 \pm 4.57 | 26.19 \pm 3.82 | 18.74 \pm 3.6 | 133.08 \pm 18.79 |
| | <i>p</i> | 0.048* | 0.999 | 0.263 | 0.808 | 0.525 | 0.267 | 0.234 |
| | <i>Cohen's d</i> | 0.297 | 0 | 0.169 | 0.037 | 0.098 | 0.171 | 0.178 |
| Use of mouthwash/mouth spray | Yes | 23.22 \pm 4.34 | 18.84 \pm 4.5 | 22.23 \pm 3.47 | 26.66 \pm 4.48 | 26.49 \pm 4 | 19.59 \pm 3.66 | 137.03 \pm 16.75 |
| | No | 22.28 \pm 4.61 | 17.87 \pm 5.3 | 21.71 \pm 4.18 | 26.33 \pm 4.69 | 26.42 \pm 3.76 | 18.69 \pm 3.55 | 133.31 \pm 18.05 |
| | <i>p</i> | 0.141 | 0.162 | 0.328 | 0.602 | 0.906 | 0.080 | 0.130 |
| | <i>Cohen's d</i> | 0.210 | 0.197 | 0.135 | 0.072 | 0.018 | 0.250 | 0.214 |
| Frequency of visiting the dentist | Regular | 23.22 \pm 4.45 | 18.35 \pm 4.95 | 21.95 \pm 3.75 | 26.98 \pm 4.63 | 26.95 \pm 3.83 | 19.64 \pm 3.4 | 137.1 \pm 16.81 |
| | Irregular | 22.31 \pm 4.49 | 18.42 \pm 4.88 | 22.02 \pm 3.91 | 26.01 \pm 4.48 | 25.94 \pm 3.88 | 18.68 \pm 3.8 | 133.38 \pm 17.94 |
| | <i>p</i> | 0.150 | 0.914 | 0.899 | 0.132 | 0.064 | 0.059 | 0.130 |
| | <i>Cohen's d</i> | 0.204 | 0.014 | 0.018 | 0.213 | 0.262 | 0.266 | 0.214 |

HPLP II Health-Promoting Lifestyle Profile II, Health responsibility, nutrition, stress management, etc. scored on a 4-point Likert scale. This table compares HPLP II subscale scores based on demographic and behavioral variables such as gender, smoking, and oral hygiene habits

Student t test * $p < 0.05$

Table 4 Comparison of Health-Promoting lifestyle profile II (HPLP II) subscale scores by DMFT, gingival index (GI), and plaque index (PI) categories

| | | Health responsibility | Physical Activity | Nutrition | Spiritual Growth | Interpersonal Relationship | Stress Management | HPLP II |
|------|-------------------------------|-----------------------|-------------------|---------------|------------------|----------------------------|-------------------|----------------|
| | | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD | Mean ± SD |
| DMFT | Extremely low | 22.03 ± 3.48 | 18.38 ± 5.82 | 22.14 ± 3.46 | 27.69 ± 4.03 | 27.62 ± 3.86 | 19.93 ± 3.92 | 137.79 ± 14.67 |
| | Low | 22.74 ± 3.89 | 19.95 ± 5.14 | 21.63 ± 4.31 | 26.21 ± 3.52 | 26.21 ± 3.77 | 18.26 ± 3.46 | 135 ± 13.75 |
| | Standard | 23.13 ± 5.06 | 18.9 ± 4.9 | 21.85 ± 3.94 | 27.36 ± 4.8 | 26.44 ± 4.12 | 18.97 ± 4.13 | 136.64 ± 20.5 |
| | High | 23.26 ± 4.6 | 18.76 ± 5.23 | 22.45 ± 3.79 | 26 ± 4.69 | 26.29 ± 3.66 | 19.1 ± 3.75 | 135.86 ± 18.2 |
| | Extremely high | 22.62 ± 4.65 | 17.49 ± 4.18 | 21.82 ± 3.86 | 25.95 ± 4.78 | 26.16 ± 3.93 | 19.25 ± 3.2 | 133.29 ± 17.29 |
| | ¹ p | 0.808 | 0.287 | 0.909 | 0.289 | 0.531 | 0.626 | 0.768 |
| | Eta Squared (η ²) | 0.008 | 0.025 | 0.005 | 0.025 | 0.016 | 0.013 | 0.009 |
| GI | Mild | 23.51 ± 4.4 | 18.75 ± 5.06 | 22.46 ± 4.01 | 26.8 ± 4.61 | 26.65 ± 4.18 | 19.44 ± 3.78 | 137.6 ± 17.02 |
| | Moderate | 21.83 ± 4.44 | 17.92 ± 4.68 | 21.38 ± 3.5 | 26.13 ± 4.52 | 26.2 ± 3.45 | 18.82 ± 3.41 | 132.27 ± 17.6 |
| | ² p | 0.008* | 0.237 | 0.046* | 0.300 | 0.409 | 0.229 | 0.031* |
| | 95% CI | 0.443–2.915 | -0.545–2.195 | 0.019–2.142 | -0.605–1.952 | -0.616–1.504 | -0.393–1.634 | 0.490–10.156 |
| | Cohen's d | 0.380 | 0.170 | 0.287 | 0.147 | 0.117 | 0.172 | 0.308 |
| PI | Good | 22.91 ± 4.56 | 18.35 ± 4.91 | 22.12 ± 3.78 | 26.58 ± 4.66 | 26.63 ± 3.92 | 19.41 ± 3.78 | 135.99 ± 17.85 |
| | Fair | 22.12 ± 4.06 | 18.58 ± 4.94 | 21.3 ± 4.04 | 26.12 ± 4.14 | 25.58 ± 3.57 | 17.94 ± 2.4 | 131.64 ± 14.78 |
| | ² p | 0.360 | 0.809 | 0.263 | 0.599 | 0.155 | 0.005* | 0.190 |
| | 95% CI | -0.899–2.468 | -2.071–1.618 | -0.618–2.249 | -1.260–2.177 | -0.401–2.503 | 0.454–2.484 | -2.178–10.881 |
| | Cohen's d | 0.183 | 0.047 | 0.210 | 0.104 | 0.280 | 0.464 | 0.265 |

DMFT Extremely low (0.0–1.1), Low (1.2–2.6), Standard (2.7–4.4), High (4.5–6.5), Extremely high (> 6)

GI Mild (0.1–1.0), Moderate (1.1–2.0)

PI Good (0.0–0.9), Fair (1.0–1.9)

This table shows mean HPLP II scores and subscales stratified by oral health index categories, with statistical significance determined via ANOVA or t-test

¹One-way ANOVA test ² Student t test *p < 0.05

Table 5 Pearson correlation between clinical oral health indices and HPLP II subscale scores

| | | DMFT | GI | PI |
|----------------------------|---|---------------|--------|---------------|
| Health responsibility | r | 0.021 | -0.113 | -0.119 |
| | p | 0.769 | 0.110 | 0.091 |
| Physical Activity | r | -0.107 | -0.006 | -0.026 |
| | p | 0.130 | 0.929 | 0.713 |
| Nutrition | r | -0.016 | -0.100 | -0.089 |
| | p | 0.820 | 0.157 | 0.208 |
| Spiritual Growth | r | -0.153 | -0.060 | -0.086 |
| | p | 0.030* | 0.398 | 0.221 |
| Interpersonal Relationship | r | -0.116 | -0.033 | -0.148 |
| | p | 0.100 | 0.642 | 0.035* |
| Stress Management | r | -0.017 | -0.063 | -0.186 |
| | p | 0.812 | 0.370 | 0.008* |
| HPLP II | r | -0.098 | -0.089 | -0.152 |
| | p | 0.166 | 0.208 | 0.031* |

DMFT Decayed, Missing, and Filled Teeth, GI Gingival Index, PI Plaque Index, HPLP II Health-Promoting Lifestyle Profile II. This table presents correlation coefficients between clinical indices (DMFT, GI, PI) and health-promoting lifestyle domains, indicating the direction and strength of relationships

Pearson correlation analysis *p < 0.05

identified between the plaque index and the interpersonal relationships, stress management subscales, and the total HPLP II score, all of which were statistically significant. Although some correlations reached statistical

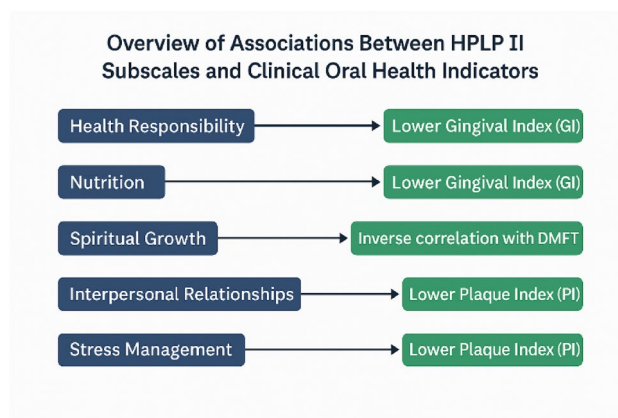


Fig. 2 Overview of associations between HPLP II subscales and clinical oral health indicators. Associations were based on cross-sectional observations and did not imply causality. The figure summarizes significant associations between behavioral domains and oral health indices observed in this study

significance (p < 0.05), the strength of these associations was weak (r < 0.20), indicating limited clinical relevance.

The Fig. 2 summarizes associations between HPLP II subscales and clinical oral health indicators. Higher health responsibility and nutrition scores were associated with lower gingival index (GI) values. Stress management and interpersonal relationship scores were associated with lower plaque index (PI) values. There is a weak

inverse correlation observed between spiritual growth and the decayed, missing, and filled teeth (DMFT) index.

Discussion

The present study investigated the relationship between health-promoting lifestyle behaviors—assessed using the HPLP II—and clinical oral health indicators among fourth-year dental students. Given the cross-sectional design, all associations reported in this study should be interpreted as non-causal and observational in nature. The findings revealed that the majority of students demonstrated good levels of health-promoting behaviors. Moreover, significant associations were observed between specific HPLP II subscales and clinical oral health measures, particularly the gingival and plaque indices.

Better gingival health was primarily associated with higher nutrition and health responsibility scores, underscoring that awareness of diet and self-care behaviors may serve as protective factors for periodontal health. This supports prior research indicating that good nutritional habits, such as reduced sugar intake and adequate vitamin consumption, contribute to reduced gingival inflammation and improved periodontal status [1, 31]. In addition, participants with lower plaque index scores reported significantly higher stress management scores. Effective stress regulation and coping behaviors may indirectly be associated with oral hygiene consistency and immune resilience, ultimately being linked to lower levels of plaque accumulation and associated inflammation [17, 24]. These associations, while statistically significant, should still be interpreted as non-causal. These findings are consistent with the conceptual framework presented in Fig. 1, which illustrates how higher scores in health-promoting lifestyle domains correspond to improved oral health outcomes, particularly in relation to plaque control and gingival health.

While several significant associations were observed, it remains essential to interpret why some anticipated relationships were not statistically significant. This likely reflects the multifactorial nature of oral health, where behavioral, biological, and environmental factors interact in complex ways. For instance, no clear associations were found between the DMFT index and most HPLP II domains, except for a weak link with spiritual growth. This suggests that caries development may be shaped more by cumulative exposures—such as fluoride intake, genetic predisposition, and long-term dietary habits—than by short-term self-reported behaviors measured through the HPLP II [32–34]. Similarly, the absence of a relationship between physical activity and clinical indices (DMFT, GI, PI) supports the notion that general exercise habits have limited direct influence on oral health outcomes in the short term. However, psychosocial domains

such as stress management and spiritual growth may indirectly affect oral health by promoting better coping skills, adherence to preventive behaviors, and stress-related physiological regulation.

It should also be emphasized that some statistically significant findings, particularly those with weak correlation coefficients, may not hold clinical relevance. Interpreting such relationships cautiously helps distinguish between numerical significance and meaningful behavioral patterns. Furthermore, the lack of association between toothbrushing frequency and overall HPLP II scores could be attributed to a ceiling effect, as most students reported regular brushing, leaving limited variability for statistical differentiation. Collectively, these results illustrate the complex and multifactorial nature of health behavior–oral health interactions, underscoring the need for longitudinal and multi-center studies that better capture behavioral dynamics and their long-term clinical impact. The absence of significant correlations between the DMFT index and most HPLP II subscales warrants critical consideration. Unlike indices such as PI and GI, which reflect current behavioral and oral hygiene patterns, DMFT represents a cumulative record of lifetime caries experience. Therefore, recent behavioral changes—such as improved nutrition or increased preventive care—may not immediately be reflected in DMFT scores. Moreover, the relatively young age and homogeneous background of dental students could contribute to limited variation in caries experience, reducing the statistical power to detect meaningful associations. In addition, self-reported behavioral data may not fully capture nuances such as diet frequency, fluoride exposure, or early childhood caries history, all of which strongly influence DMFT outcomes. Collectively, these factors may explain why DMFT showed weak or non-significant correlations with current health-promoting lifestyle domains.

While interpreting the overall findings, it is notable that the mean total HPLP II score in this study was comparable to previous research among health sciences students. This consistency across studies indicates that students in health-related fields generally demonstrate moderate engagement in health-promoting behaviors, particularly in psychosocial domains such as spiritual growth and interpersonal relationships, while physical activity and health responsibility remain weaker areas [18, 23]. Such trends may reflect the influence of academic exposure to health concepts and students' perceived professional identity as future healthcare providers.

In contrast, studies involving non-dental university populations reported lower overall HPLP II scores, often with similar patterns of low physical activity and health responsibility [17, 21]. These differences suggest that dental and other health sciences students may be more

aware of preventive behaviors due to the integration of oral and general health knowledge in their training. This discipline-specific pattern underscores the need for educational strategies that reinforce weak domains, particularly physical activity and personal health responsibility, within dental curricula.

A weak inverse correlation was identified between the DMFT index and the spiritual growth subscale. While not strong, this association may suggest that students with higher levels of spiritual development—reflecting a sense of purpose, personal growth, and inner motivation—tend to adopt better preventive oral health practices over time. Although the clinical relevance of this relationship is limited, it may suggest that psychosocial well-being could influence long-term oral health status, including caries experience. Nevertheless, although statistically significant, this finding does not imply a direct cause-and-effect relationship and should be interpreted with caution. Additionally, a negative correlation was observed between plaque index scores, total HPLP II scores, and specific subscales such as interpersonal relationships and stress management. These findings may suggest that students with better emotional regulation and stronger social ties are more inclined to practice effective oral hygiene. The correlation between stress management and plaque index may be explained through both behavioral and physiological pathways. Students with better stress management skills are more likely to maintain consistent oral hygiene routines and demonstrate higher adherence to preventive behaviors, such as regular brushing and flossing. Conversely, psychological stress has been associated with neglect of self-care behaviors, leading to increased plaque accumulation and gingival inflammation. This aligns with prior literature emphasizing that psychological well-being and strong interpersonal connections play a role in the adoption of healthy routines, including oral hygiene practices [17, 24]. Again, these associations are correlational in nature and cannot be considered causal due to the study's design.

The absence of a strong relationship between overall HPLP II scores and the DMFT index aligns with previous studies reporting limited associations between health-promoting behaviors and caries experience among dental students [25]. This reinforces the understanding that caries development is influenced more by long-term biological and environmental exposures than by short-term lifestyle behaviors.

Male students reported higher physical activity levels than females, a finding consistent with previous studies conducted in Turkey and internationally [10, 11, 35]. However, this interpretation should be approached cautiously, as potential gender-related social or cultural factors may shape self-reporting and behavior patterns, leading to possible bias or imbalance in observed trends.

Non-smokers exhibited higher nutrition scores, supporting existing evidence that tobacco use negatively correlates with health-conscious dietary behaviors [36].

Students who used dental floss tended to score higher on health responsibility, reinforcing the idea that they are more attentive to self-care and preventive oral hygiene practices. Previous literature has also reported that dental students who regularly use dental floss and perform other preventive practices are likelier to exhibit health-promoting behaviors [23, 37].

Universities are critical for implementing health promotion strategies, particularly among young adults undergoing substantial lifestyle transitions [38]. The academic pressure and social challenges associated with university life can significantly influence students' health-related behaviors and overall well-being [39]. Consequently, higher education institutions are expected to cultivate environments that support and encourage the development of health-promoting behaviors. This settings-based approach to health promotion is increasingly recognized for fostering student well-being and enhancing academic achievement [24, 40].

When the findings of the present study are considered in a global context, they are largely consistent with international literature on dental students' health-promoting behaviors. Studies from Croatia, Saudi Arabia, and Japan have similarly reported moderate HPLP II scores, with the highest ratings in psychosocial domains such as spiritual growth and interpersonal relationships, and the lowest in physical activity and health responsibility [18, 23, 41]. Comparable results have also been documented among students in Latin America, suggesting that health sciences education fosters awareness of positive lifestyle behaviors, though gaps remain in active engagement and personal responsibility [42].

These cross-national patterns imply that the determinants of lifestyle behaviors among dental students may be more universal than country-specific, reflecting shared academic environments, comparable age groups, and similar stressors associated with clinical training. However, sociocultural differences—such as gender norms, dietary habits, and public health emphasis—may still shape the expression of certain health behaviors in different regions. Overall, these findings support the need for cross-cultural health promotion frameworks that can be adapted to various educational and cultural contexts.

Policy and curriculum implications

The present study showed that health-related behaviors are related to many factors, including oral health. These findings suggest a need for curriculum-level policy changes within dental education. By formally embedding health promotion and lifestyle education into academic programs, institutions can foster a more holistic

understanding of health in future dental professionals [43, 44]. Accreditation bodies and curriculum designers should consider requiring structured health behavior components—such as modules on nutrition, mental well-being, and stress resilience—as part of core dental training. This policy-level emphasis on preventive care and health promotion could better prepare students for patient-centered, holistic dental practice. To support the development of sustainable health-promoting behaviors among students, specific interventions can be integrated into the dental curriculum. For instance, the inclusion of lifestyle medicine principles—emphasizing diet, exercise, stress management, and behavioral change—can promote personal well-being and clinical competence. Furthermore, training in motivational interviewing techniques could equip students with effective communication tools to support patient behavior positively, aligning with their future roles as preventive oral health advocates. Policymakers and accreditation bodies should consider formally recognizing health promotion as a competency area in dental education, ensuring that future practitioners embody preventive, patient-centered, and interdisciplinary approaches to care [45].

Limitations

This study has several limitations that should be considered. Foremost, its cross-sectional design precludes any causal inference; the results only reflect associations between variables measured at a single point in time. Because this research employed a cross-sectional design, the temporal sequence between lifestyle behaviors and oral health outcomes cannot be established, and the observed associations should be interpreted as correlational rather than causal.

Second, although the inclusion of only fourth-year dental students may limit the generalizability of the findings, this targeted approach allowed for the evaluation of a relatively homogeneous group with comparable educational exposure and clinical responsibilities. This design strengthened internal consistency and enabled a more focused assessment of the relationship between lifestyle behaviors and oral health outcomes. Nevertheless, future studies including students from different academic years and institutions would be valuable to confirm and extend these findings.

Third, all oral health behaviors—such as tooth brushing frequency, use of dental floss, and smoking status—were self-reported. This introduces the possibility of response bias, as participants may have overreported socially desirable behaviors (e.g., frequent brushing) and underreported less favorable ones (e.g., smoking), potentially affecting the accuracy of the results. Similarly, the HPLP II is a self-reported measure, and its results may be prone to overestimation of positive health behaviors

due to social desirability bias. As the study relied on self-reported questionnaires, responses may have been influenced by social desirability bias, potentially leading to an overestimation of positive health behaviors. This limitation should be considered when interpreting the findings. Moreover, the study did not collect data on participants' socioeconomic background, academic workload, or mental health status—all of which may act as confounding factors that influence both health behaviors and clinical oral health outcomes. The absence of these variables limits the ability to fully interpret the observed associations. Future studies should consider incorporating such variables to better contextualize and control for the influence of these potential confounders. Additionally, gender-related differences should be interpreted with caution, as social desirability or cultural expectations may influence self-reported behaviors differently across male and female participants, potentially introducing gender-based response bias.

Fourthly, radiographic evaluations were not included due to ethical concerns about unnecessary radiation exposure. As a result, some interproximal or occult carious lesions may have been missed, potentially leading to an underestimation of the DMFT scores.

Another limitation of this study is the absence of socioeconomic and dietary information, which could have acted as confounding factors in the observed associations. Socioeconomic status is known to influence both lifestyle behaviors and oral health outcomes through factors such as access to care, health literacy, and dietary quality. Similarly, dietary patterns, including frequency of sugar consumption and meal timing, play a crucial role in caries development and overall oral health. The lack of these variables may have restricted the ability to account for their potential effects fully. Future research incorporating detailed socioeconomic and nutritional data would provide a more comprehensive understanding of the behavioral and environmental determinants of oral health among dental students.

Additionally, the generalizability of the findings may be limited by the cultural and educational context of the study population. Health-promoting behaviors and oral health outcomes are influenced by sociocultural norms, institutional structures, and curriculum emphasis, which can vary substantially between countries and universities. Therefore, the results should be interpreted with caution when applied to different populations, as variations in health education systems, lifestyle perceptions, and academic stress levels may lead to differing behavioral trends and clinical outcomes. Future multi-center or cross-cultural studies are recommended to explore these associations in diverse educational and cultural settings.

Lastly, due to the cross-sectional design and reliance on self-reported data, causality cannot be inferred, and social desirability bias may have influenced results.

Conclusion

Significant associations were found between specific domains of health-promoting behaviors—such as nutrition, stress management, and health responsibility—and clinical indicators of oral health, particularly gingival and plaque indices. Students who engage in healthier lifestyle behaviors tend to exhibit better oral hygiene and periodontal outcomes. These results support the study hypothesis that students with higher levels of health-promoting behaviors tend to exhibit better clinical oral health outcomes.

Integrating structured health promotion content into the dental curriculum is important. Incorporating behavioral education components—such as stress management, nutrition awareness, and oral health responsibility—could help enhance students' personal and professional well-being. Equipping dental students with these skills can enhance their role as preventive and patient-centered care providers. In line with accreditation standards that emphasize preventive care and health promotion, incorporating such content into dental curricula can help ensure graduates are prepared to meet both educational and professional expectations.

Future longitudinal and interventional studies are required to confirm these behavioral impacts and to explore how sustained health promotion strategies influence oral health outcomes across diverse student populations. Future research should aim to strengthen these preliminary findings through longitudinal, multi-center, and interventional designs that can better capture behavioral changes over time and clarify their causal relationships with oral health outcomes. Comparative analyses across different cultural and educational contexts would also help determine the generalizability of the present results. Moreover, intervention-based educational trials focusing on health-promoting behaviors among dental students could provide practical insights for curriculum development and policy planning.

Abbreviations

| | |
|---------|---------------------------------------|
| HPLP II | Health-Promoting Lifestyle Profile II |
| DMFT | Decayed, Missing, and Filled Teeth |
| GI | Gingival index |
| PI | Plaque index |
| WHO | World Health Organization |

Supplementary Information

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Supplementary Material 1.

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Authors' contributions

BBA conceptualized the manuscript. BBA, NU, and NA carried out the methodology; MB conducted data analysis, drafted, and edited the manuscript. All authors subsequently revised the drafts. All authors reviewed and approved the final manuscript.

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Data availability

All data generated or analysed during this study are included in this published article (and its Supplementary Information files).

Declarations

Ethics approval and consent to participate

Ethics committee approval was received for this study from the Ethics Committee of Istanbul Medipol University (REF: E-10840098-772.02-2948). The research was carried out in compliance with the policy set out in the Declaration of Helsinki, and informed consent in written form was obtained from the participants included in the study.

Consent for publication

Not applicable.

Competing interests

The authors declare no competing interests.

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