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Dental Hygienists' Perceptions of Tooth Whitening Methods, Effectiveness and Patient Satisfaction: A Cross-Sectional Study

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ABSTRACT: Tooth whitening has become one of the most frequently requested aesthetic dental procedures worldwide. Dental hygienists play an important role in patient education, prevention, and the implementation of whitening procedures. However, questions remain regarding the effectiveness, safety, and long-term outcomes of different whitening methods.

Aim: To evaluate the tooth whitening methods used by dental hygienists and to assess their perceptions regarding whitening effectiveness, adverse effects and patient satisfaction associated with different whitening approaches.

Methods: The study employed scientific literature analysis, a quantitative research approach, and a questionnaire survey to assess parental attitudes, knowledge, and practices regarding oral health care in preschool children.

Materials and Methods: A cross-sectional questionnaire survey was conducted among 110 dental hygienists. Data were collected using a questionnaire that had not undergone formal validation. The questionnaire covered indications and contraindications for tooth whitening, adverse effects, patient satisfaction as perceived by dental hygienists, and respondents' professional experiences with tooth whitening. Data were analysed using IBM SPSS Statistics, version 27.0. Categorical variables were summarised as frequencies and percentages. Associations between categorical variables were examined using Pearson's chi-square test, and the strength of these associations was quantified using Cramér's V. Paired ratings of perceived patient satisfaction with two whitening methods were compared using the Wilcoxon signed-rank test. Statistical significance was set at $p < 0.05$.

Results: Combined in-office and home whitening (67.3%) and LED-assisted whitening (66.4%) were the most frequently used techniques. Home tray whitening was most often perceived as providing the longest-lasting whitening effect (67.6%). Tooth sensitivity was the most frequently reported complication (69.1%). Patients were significantly more satisfied with home tray whitening than with in-office whitening (95.3% vs. 69.5%; $p < 0.001$). Repeat whitening intervals were significantly associated with satisfaction with in-office whitening ($p < 0.001$; Cramer's V = 0.337) and perceptions of the effectiveness of scientific evidence regarding whitening procedures ($p < 0.001$; Cramer's V = 0.518). Perceiving home tray whitening as the longest-lasting method was significantly associated with whitening technique selection, lower perceived impact on dental tissues, and reports of tooth sensitivity (all $p < 0.05$).

Conclusions: Combined in-office and home whitening and LED-assisted whitening were the most commonly used whitening techniques. Compared with in-office whitening, home tray whitening was perceived as providing longer-lasting whitening outcomes and was associated with significantly higher patient satisfaction. Perceived whitening effectiveness was associated with several clinical factors, including whitening technique selection and perceived impact on dental tissues.

KEYWORDS: Tooth whitening; dental hygienists; whitening methods; patient satisfaction; effectiveness

I. INTRODUCTION

Tooth whitening has become one of the most commonly requested procedures in aesthetic dentistry due to increasing public attention toward dental appearance and smile aesthetics. Modern patients frequently seek minimally invasive and cost-effective procedures that improve dental appearance while preserving healthy tooth structure. Compared with restorative aesthetic treatments, whitening procedures are considered attractive because they are relatively simple, affordable, and non-invasive (Maran et al. (2024), Hass et al. (2019), and Ribeiro et al. (2024). The growing social emphasis on facial appearance and smile attractiveness has contributed to the increasing popularity of whitening procedures among patients of different age groups.

Tooth color is influenced by multiple intrinsic and extrinsic factors. Extrinsic discoloration is commonly associated with dietary habits, smoking, poor oral hygiene, coffee, tea, red wine consumption, and the accumulation of chromogenic substances on the enamel surface. Intrinsic discoloration may result from trauma, pulp necrosis, tetracycline use, fluorosis, aging, genetic factors, or endodontic treatment (Mailart et al., 2022; Aidos et al., 2024).The optical properties of enamel and dentin significantly influence

tooth color perception. Enamel thickness, translucency, mineral composition, and surface morphology determine light reflection and absorption. Thicker enamel generally produces a lighter appearance, whereas irregular surfaces and dentin exposure increase translucency and darker shades (Aidos et al., 2024). Furthermore, several studies have demonstrated that aging contributes to discoloration through enamel wear and increased dentin visibility. Endodontic materials and pulpal hemorrhage may also cause internal discoloration requiring specific whitening approaches.

The growing availability of whitening products and techniques has significantly expanded patient choices. Contemporary whitening procedures include professionally performed in-office tooth whitening, dentist-supervised at-home whitening, whitening strips, whitening toothpastes, combined whitening techniques, and over-the-counter products. Tooth whitening procedures are generally categorized into in-office whitening, at-home whitening, combined whitening techniques, and internal whitening for non-vital teeth. Professional in-office whitening usually involves higher concentrations of hydrogen peroxide and may be activated by light or heat sources to accelerate oxidation and improve whitening efficiency (Anisimova et al., 2023; Ribeiro et al., 2024; Féliz-Matos et al., 2015; Veloso et al., 2026; Al-Angari et al., 2021). In contrast, at-home whitening methods commonly utilize lower concentrations of carbamide peroxide or hydrogen peroxide applied through custom trays or whitening strips. Although these procedures require longer treatment duration and greater patient compliance, they are frequently associated with reduced sensitivity and improved long-term stability (Ribeiro et al., 2024; Šveckutė and Mameniškis, 2020; Butera et al., 2024). Combined whitening approaches, which involve professional whitening followed by at-home maintenance, have been reported to provide optimal aesthetic outcomes and longer-lasting effects (Butera et al., 2024).

Despite the wide accessibility of whitening products, their effectiveness and safety remain subjects of scientific discussion (Benahmed et al., 2022; Maran et al., 2019; Jin et al., 2024; Al-Angari et al., 2021). The whitening process is primarily based on oxidation reactions involving hydrogen peroxide or carbamide peroxide. These agents penetrate enamel and dentin, breaking down chromogenic molecules responsible for tooth discoloration (Fioresta et al., 2023). Studies have demonstrated that hydrogen peroxide oxidizes organic pigments and modifies the optical properties of dental tissues, thereby improving tooth brightness and color uniformity (Fioresta et al., 2023; Abrantes et al., 2021; Mailart et al., 2022).However, whitening procedures may also lead to adverse effects such as tooth sensitivity, gingival irritation, enamel alterations, and patient dissatisfaction when inappropriate methods are selected [(Kahler, 2022; Abrantes et al., 2021; Bersezio et al., 2024; de Geus et al., 2025; Butera et al., 2024). Tooth sensitivity is considered the most common side effect and is usually temporary, resulting from peroxide penetration into dentinal tubules. Gingival irritation may occur because of improper tray adaptation or accidental contact between whitening gel and soft tissues (Bersezio et al., 2024; de Geus et al., 2025; Butera et al., 2024).

Recent scientific investigations have focused on developing safer whitening materials and technologies aimed at reducing enamel alterations and minimizing postoperative sensitivity (Kahler, 2022). Innovations in whitening products, including remineralizing agents and modified peroxide formulations, seek to improve both patient comfort and clinical outcomes while maintaining whitening effectiveness.

Dental hygienists play an important role in preventive care, patient education, and the selection of appropriate whitening methods. Their clinical experience allows them to assess indications and contraindications, identify risk factors, and provide recommendations tailored to individual patient needs (Hass et al., 2019; Benahmed et al., 2022). Dental hygienists contribute substantially to patient education and preventive care in aesthetic dentistry by evaluating oral health status, recommending suitable whitening methods, monitoring treatment outcomes, and ensuring patient safety during whitening procedures. Professional knowledge regarding whitening indications, contraindications, and possible adverse effects is essential for achieving satisfactory clinical outcomes and minimizing complications.

Although numerous clinical studies have investigated the efficacy, safety, and adverse effects of tooth whitening procedures, relatively little is known about how dental hygienists perceive whitening effectiveness, safety, and patient satisfaction in everyday clinical practice. Dental hygienists play a key role in patient education, treatment selection, and monitoring of whitening outcomes; however, evidence regarding their preferences for different whitening techniques and their experiences with treatment effectiveness and adverse effects remains limited. This knowledge gap is particularly evident in Eastern European countries, where data on professional perspectives toward tooth whitening are scarce (Hass et al., 2019; Šveckutė and Mameniškis, 2020; Ellakany et al., 2021). Therefore, further research is needed to better understand the whitening methods used in dental hygiene practice and the factors influencing professional recommendations.

The aim of this study was to assess dental hygienists' perceptions of tooth whitening methods and to compare in-office and at-home whitening procedures in terms of perceived effectiveness, adverse effects, and patient satisfaction.

II. SUBJECT AND METHODS

Study Design

A quantitative cross-sectional survey was conducted among dental hygienists in Lithuania to explore their professional

experiences with tooth whitening, including whitening methods used in clinical practice, indications and contraindications, perceived effectiveness, adverse effects, and patient satisfaction.

Setting

The study was conducted online using an anonymous, self-administered questionnaire distributed to dental hygienists through social media groups targeting dental hygiene professionals. Participation was voluntary.

Study Duration

Data collection took place between February and April 2025.

Sample Size and Sampling

A total of 110 licensed dental hygienists participated in the study and were included in the analysis. A non-probability convenience sampling approach was used. Participants were recruited through online distribution of the questionnaire among dental hygienists.

Inclusion and Exclusion Criteria

Inclusion criteria:

Being at least 18 years of age.
Holding a valid dental hygienist licence.
Actively practising as a dental hygienist.

Exclusion criteria:

- Not meeting the eligibility criteria.
- Questionnaires that did not meet the study's inclusion requirements.

According to the study records, all respondents met the inclusion criteria, and no questionnaires were excluded from the analysis.

Data Collection Procedures

Data were collected using an author-developed questionnaire based on relevant scientific literature. The questionnaire was not formally validated. It covered the following areas:

1. Sociodemographic and professional characteristics.
2. Indications and contraindications for tooth whitening.
3. Tooth whitening methods used in clinical practice.
4. Perceived effectiveness and longevity of whitening procedures.
5. Patient satisfaction with whitening outcomes.
6. Adverse effects and complications associated with tooth whitening.

Measures

The primary outcomes included the whitening methods reported by dental hygienists, their perceptions of the effectiveness and longevity of different whitening approaches, reported adverse effects, and perceived patient satisfaction. Additional measures included respondents' knowledge of whitening indications and contraindications and associations between selected professional and clinical practice characteristics and their perceptions of whitening outcomes.

III. RESULTS

A total of 110 dental hygienists participated in the study. Most respondents were female (96.4%) and worked in urban areas (94.5%). The mean professional experience was 8.81 ± 6.13 years, with a median of 8.5 years (IQR: 4.0–11.0). Among respondents who reported their professional experience (n = 98), 38.8% had ≤5 years of experience, 31.6% had 6–10 years, and 29.6% had more than 10 years of experience. Regarding clinical practice, 30.9% of respondents reported performing 1–2 in-office whitening procedures per month and an equal proportion reported performing 3–5 procedures monthly, while 17.3% performed more than five procedures per month (Table 1).

Table 1. Characteristics of participants, n (%)

Characteristic	n	%
Gender		
Female	106	96.4
Male	2	1.8
Not reported	2	1.8
Work location		
Urban	104	94.5
Rural	2	1.8

Not reported	4	3.6
Professional experience		
≤5 years	38	38.8
6–10 years	31	31.6
>10 years	29	29.6
Not reported	12	10.9
Monthly number of in-office whitening procedures		
None	15	13.6
1–2 procedures	34	30.9
3–5 procedures	34	30.9
>5 procedures	19	17.3
Not reported	8	7.3

Professional experience (years): mean ± SD = 8.81 ± 6.13; median (IQR) = 8.5 (4.0–11.0).

Note: Percentages were calculated from the total sample (n = 110). "Not reported" indicates participants who did not provide sufficient information.

The most commonly used whitening techniques in clinical practice were combined in-office and home whitening (n=74, 67.3%) and LED-assisted whitening (n=73, 66.4%). In contrast, laser whitening (13.6%) and over-the-counter whitening products (7.3%) were used considerably less frequently by respondents (Table 2).

Table 2. Tooth whitening methods used in clinical practice, n (%)

Item	n	% (95% CI)
Combined in-office and home whitening	74	67.3 (58.5–76.0)
LED-assisted whitening	73	66.4 (57.5–75.2)
Other	29	26.4 (18.1–34.6)
In-office whitening with hydrogen peroxide	27	24.5 (16.5–32.6)
In-office whitening with carbamide peroxide	21	19.1 (11.7–26.4)
Laser whitening	15	13.6 (7.2–20.0)
Over-the-counter whitening products	8	7.3 (2.4–12.1)

Note: Multiple responses were possible; percentages were calculated from the total sample (n = 110). Values are presented as percentage (95% confidence interval).

Aesthetic reasons were the most frequently reported indication for tooth whitening (84.5%), followed by age-related tooth yellowing (35.5%) and discoloration caused by tobacco, coffee, or other staining products (33.6%). The most commonly reported contraindications were pregnancy or breastfeeding (95.5%), age under 18 years (90.9%), gingival disease or periodontitis (88.2%), dental caries (79.1%), and tooth sensitivity (73.6%) (Table 3).

Table 3. Main indications and contraindications for tooth whitening, n (%)

Group	Item	n	% (95% CI)
Indications	Aesthetic reasons	93	84.5 (76.6–90.1)
	Age-related yellowing	39	35.5 (27.1–44.7)
	Discoloration caused by tobacco, coffee or other staining products	37	33.6 (25.5–42.9)
	Tooth colour change after dental treatment	27	24.5 (17.5–33.4)
	Other	17	15.5 (9.9–23.4)
Contraindications	Pregnancy or breastfeeding	105	95.5 (89.8–98.0)
	Age under 18 years	100	90.9 (84.1–95.0)
	Gingival disease or periodontitis	97	88.2 (80.8–93.0)
	Dental caries	87	79.1 (70.6–85.6)
	Tooth sensitivity	81	73.6 (64.7–81.0)
	Other	6	5.5 (2.5–11.4)

Note: Multiple responses were possible; percentages and 95% confidence intervals were calculated based on the total sample (n = 110). Confidence intervals were estimated using the Wilson method.

As shown in Table 4, tooth sensitivity was the most frequently reported complication following whitening procedures. Uneven tooth shade change and gingival irritation were reported considerably less frequently. Other complications were reported by a minority of respondents (Table 4).

Table 4. Complications observed after whitening procedures, n (%)

Item	n	% (95% CI)
Tooth sensitivity	76	69.1 (59.9–77.0)
Uneven tooth shade change	26	23.6 (16.7–32.3)
Other	19	17.3 (11.3–25.4)
Gingival irritation	14	12.7 (7.7–20.3)

Note: Multiple responses were possible; percentages and 95% confidence intervals were calculated based on the total sample (n = 110). Confidence intervals were estimated using the Wilson method.

Home tray whitening was most frequently perceived as the method providing the longest-lasting whitening effect (n=73, 67.6% of valid responses), whereas in-office peroxide whitening (13.0%) and laser whitening (3.7%) were selected considerably less frequently (Table 5).

Table 5. Tooth whitening method perceived as providing the longest-lasting whitening effect, n (%)

Method	n	% (95% CI)
In-office peroxide whitening	14	13.0 (6.6–19.3)
Laser whitening	4	3.7 (0.2–7.3)
Home tray whitening	73	67.6 (58.8–76.4)
Other	17	15.7 (8.8–22.6)

Note: Percentages were calculated from valid responses (n = 108). Values are presented as percentage (95% confidence interval).

Patient satisfaction was significantly higher for home tray whitening than for in-office whitening. The proportion of respondents reporting that patients were satisfied or very satisfied was 95.3% (95% CI: 91.3–99.3) for home tray whitening (n = 101/106) and 69.5% (95% CI: 60.7–78.3) for in-office whitening (n = 73/105). The paired ordinal comparison confirmed significantly higher satisfaction ratings for home tray whitening (Wilcoxon signed-rank test, $Z = -4.861$, $p < 0.001$, $r = 0.48$), indicating a moderate-to-large effect size (Table 6).

Table 6. Patient satisfaction according to tooth whitening method, n (%)

Method	Valid n	Satisfied/very satisfied n	Satisfied/very satisfied %	% (95% CI)
In-office whitening	105	73	69.5	69.5 (60.7–78.3)
Home tray whitening	106	101	95.3	95.3 (91.3–99.3)

Note: Paired ordinal comparison using the Wilcoxon signed-rank test ($Z = -4.861$, $p < 0.001$, $r = 0.48$).

Chi-square analysis revealed several statistically significant associations between respondents' perceptions of whitening effectiveness and selected clinical factors. Significant differences were observed between respondents who perceived home tray whitening as providing the longest-lasting whitening effect and those who perceived other whitening methods as most durable. The former group reported lower use of LED-assisted whitening and in-office hydrogen peroxide whitening and was less likely to consider rapid treatment results as an important factor when selecting a whitening technique. In contrast, they were more likely to consider a less intensive impact on dental tissues as important and to agree that tooth sensitivity is the most common complaint following whitening procedures (Table 7).

Table 7. Factors associated with perceiving home tray whitening as providing the longest-lasting whitening effect

Associated factor	Home tray whitening perceived as longest-lasting (n=73), %	Other whitening methods perceived as longest-lasting (n=37), %	χ^2	p	Cramer's V
LED-assisted whitening used	57.5	83.8	9.035	0.003	0.310
In-office hydrogen peroxide whitening used	16.4	40.5	7.454	0.006	0.286
Rapid treatment results considered important	71.2	91.9	8.259	0.004	0.301

Less intensive impact on dental tissues considered important	35.6	10.8	5.746	0.017	0.253
Agreement that tooth sensitivity is the most common complaint after whitening	97.3	89.2	7.617	0.006	0.287

Note: Pearson's chi-square test. Variables were dichotomized for inferential analyses. Percentages represent the proportion of respondents within each group who reported the associated factor.

No statistically significant associations were found between dental hygienists' professional experience and the occurrence of whitening-related complications (all $p > 0.05$) (Table 8). Tooth sensitivity was the most frequently reported complication across all professional experience groups, affecting 77.5% of respondents with ≤5 years of experience, 64.7% of those with 6–10 years of experience, and 64.5% of those with >10 years of experience. Gingival irritation and uneven tooth color change were reported less frequently and showed no significant variation according to professional experience.

Table 8. Association between professional experience and whitening-related complications

Complications	≤5 years (n=40) n (%)	6–10 years (n=34) n (%)	>10 years (n=31) n (%)	p-value
Tooth sensitivity	31 (77.5)	22 (64.7)	20 (64.5)	0.586
Gingival irritation	6 (15.0)	6 (17.6)	2 (6.5)	0.670
Uneven tooth colour change	11 (27.5)	8 (23.5)	7 (22.6)	0.532

Note: Pearson's chi-square test. No statistically significant associations were identified between professional experience and whitening-related complications (all $p > 0.05$).

Furthermore, almost all respondents (95.5%) reported that they always or frequently inform patients about potential risks and adverse effects before performing whitening procedures.

Repeat whitening intervals were significantly associated with satisfaction with in-office whitening ($p < 0.001$; Cramer's V = 0.337). Respondents who reported repeat whitening after one year most frequently indicated satisfaction with in-office whitening (87.9%), whereas lower satisfaction levels were observed among those reporting repeat whitening after two years (53.3%). Neutral evaluations were most common among respondents in the latter group (40.0%) (Table 9).

Table 9. Repeat whitening intervals according to satisfaction with in-office whitening

Repeat whitening interval	Dissatisfied n (%)	Neutral n (%)	Satisfied n (%)
After 6 months (n=9)	2 (22.2)	1 (11.1)	6 (66.7)
After 1 year (n=33)	1 (3.0)	3 (9.1)	29 (87.9)
After 2 years (n=30)	2 (6.7)	12 (40.0)	16 (53.3)
Rarely or never (n=32)	3 (9.4)	8 (25.0)	21 (65.6)

$p < 0.001$; Cramer's V = 0.337

Note: Satisfaction categories were grouped as dissatisfied (very dissatisfied/dissatisfied), neutral, and satisfied (satisfied/very satisfied). Percentages are calculated within repeat whitening interval categories.

A significant association was observed between repeat whitening intervals and respondents' perceptions of the scientific evidence supporting whitening effectiveness ($p < 0.001$; Cramer's V = 0.518). Respondents reporting repeat whitening after two years most frequently considered the available evidence sufficient (45.2%), whereas those reporting repeat whitening after one year most commonly regarded it as partially sufficient (55.9%). Overall, the findings indicate that perceptions of scientific evidence varied according to repeat whitening intervals (Table 10).

Table 10. Repeat whitening intervals according to perceived effectiveness of whitening evidence in the scientific literature

Repeat whitening interval	Sufficient evidence n (%)	Partially sufficient n (%)	Insufficient evidence n (%)	No opinion n (%)
After 6 months (n=9)	2 (22.2)	4 (44.4)	1 (11.1)	2 (22.2)
After 1 year (n=34)	10 (29.4)	19 (55.9)	4 (11.8)	1 (2.9)
After 2 years (n=31)	14 (45.2)	11 (35.5)	4 (12.9)	2 (6.5)
Rarely or never (n=33)	12 (36.4)	15 (45.5)	2 (6.1)	4 (12.1)

$p < 0.001$; Cramer's V = 0.518

Note: Percentages are calculated within repeat whitening interval categories.

DISCUSSION

The present study explored the tooth whitening methods used by participating in dental hygienists and their perceptions of treatment effectiveness, adverse effects, and patient satisfaction. The findings indicated that home tray whitening was most frequently perceived as providing the longest-lasting whitening effect, while reported patient satisfaction was higher for home tray whitening than for in-office whitening. Tooth sensitivity was identified as the most frequently reported complication associated with whitening procedures. These findings provide insight into the professional perceptions of the dental hygienists included in the study; however, they should be interpreted in the context of the study design and sampling approach.

One of the main findings was that 67.6% of respondents perceived home tray whitening as providing the longest-lasting whitening effect. This perception is broadly consistent with evidence suggesting that professionally supervised at-home whitening can provide predictable and stable whitening outcomes (Ribeiro et al., 2024). Similarly, reviews have reported comparable colour improvement following at-home and in-office whitening, although differences in treatment protocols, whitening agent concentrations, and follow-up periods may influence the durability of results (Hajeer and Hasan, 2026; Butera et al., 2024).Tray-based whitening using lower concentrations of carbamide peroxide may provide gradual colour change, but the long-term stability of whitening outcomes depends on several factors, including the protocol used and individual patient characteristics (Šveckutė and Mameniškis, 2020; Butera et al., 2024). The preference for home tray whitening observed in the present sample may reflect the participating dental hygienists' clinical experiences and perceptions of treatment durability. Nevertheless, the present study did not objectively measure colour change or follow patients over time; therefore, the findings cannot establish that home tray whitening produces more durable results than other whitening methods.

The study also identified a statistically significant association between the perception of longer-lasting whitening effects and the use of LED-assisted whitening ($\chi^2 = 9.035$, $p = 0.003$). However, the clinical benefits of light activation remain debated. Although some studies have suggested that LED activation may accelerate the whitening process or improve immediate aesthetic outcomes, systematic reviews have not consistently demonstrated superior long-term whitening effectiveness compared with conventional peroxide-based protocols (Féliz-Matos et al., 2015; Mazilu Moldovan et al., 2022; Veloso et al., 2026). The association observed in this study should therefore be interpreted cautiously. It may reflect differences in clinical experience, treatment preferences, or perceptions of immediate results rather than a direct effect of LED activation on the longevity of whitening outcomes. As the study was cross-sectional and based on self-reported information, no causal relationship can be established.

Tooth sensitivity was reported as the most common complication, with 69.1% of respondents identifying it among the adverse effects experienced by their patients. This finding is consistent with published evidence identifying tooth sensitivity as a frequent adverse effect of both in-office and at-home tooth whitening (Anisimova et al., 2023; de Geus et al., 2025; Butera et al., 2024). Hydrogen peroxide can diffuse through enamel and dentin and may contribute to transient pulpal irritation and sensitivity (Mailart et al., 2022; de Geus et al., 2025). Although sensitivity is generally temporary, its occurrence is clinically relevant because it may influence patient comfort and treatment acceptability (de Geus et al., 2025; Butera et al., 2024). The findings highlight the importance of informing patients about potential adverse effects before whitening procedures and of providing appropriate guidance on managing sensitivity. However, the reported percentage represents dental hygienists' responses rather than the prevalence of sensitivity measured directly in individual patients.

Patient satisfaction was reported to be higher for home tray whitening than for in-office whitening (95.3% vs. 69.5%, $p < 0.001$). This difference may reflect respondents' experiences or perceptions of treatment outcomes, including convenience, comfort, and the perceived duration of whitening effects. Previous studies suggest that satisfaction with tooth whitening may be influenced by the degree of colour change, treatment-related discomfort, expectations, and the maintenance of aesthetic outcomes(Maran et al., 2019; Šveckutė and Mameniškis, 2020). Nevertheless, the present study assessed dental hygienists' reports of patient satisfaction rather than collecting satisfaction ratings directly from patients. Therefore, the results should be interpreted as perceived patient satisfaction reported by participating professionals and should not be considered a direct comparison of patient-reported outcomes. Further studies involving patients themselves would be needed to investigate satisfaction with different whitening methods more directly.

Associations between perceptions of whitening longevity and factors such as rapid results, perceived effects on dental tissues, and tooth sensitivity further suggest that respondents may consider several aspects of treatment when evaluating whitening methods. These aspects include not only the anticipated aesthetic outcome but also treatment experience and perceived safety. However, such associations do not establish that any of these factors directly determine the duration or effectiveness of whitening. Further research using standardized outcome measures and longitudinal follow-up would help clarify the relationships between treatment characteristics, adverse effects, and objectively assessed whitening outcomes (Anisimova et al., 2023; Hajeer and Hasan, 2026).

The findings also underline the potential role of dental hygienists in patient education and the selection of appropriate whitening approaches. As whitening products are increasingly available through commercial and online channels, professional guidance may help patients understand treatment options, contraindications, possible adverse effects, and realistic expectations regarding outcomes (Hass et al., 2019). Dental hygienists can contribute to informed decision-making by discussing the benefits and

limitations of available methods and emphasizing the importance of choosing an approach appropriate to each patient's oral health status and needs. However, the present study did not directly evaluate the impact of dental hygienists' advice on patient behaviour, safety, satisfaction, or oral health-related quality of life; these potential benefits should therefore be considered in light of the existing literature rather than as outcomes demonstrated by this study (Hass et al., 2019; Butera et al., 2024; Hajeer and Hasan, 2026).

Overall, the findings from this sample are broadly consistent with published evidence indicating that both in-office and at-home whitening can be effective when used according to appropriate protocols (de Geus et al., 2025; Hajeer and Hasan, 2026; Butera et al., 2024). Participating in dental hygienists frequently perceived home tray whitening as providing longer-lasting results and reported higher patient satisfaction with this approach. These findings describe professional perceptions and should not be interpreted as evidence that home tray whitening is objectively superior to in-office whitening in terms of long-term colour stability or patient-reported satisfaction. The results may be useful for generating further research questions and informing discussions about clinical practice, but they should not be generalized to all dental hygienists in Lithuania without further representative research.

Several limitations should be considered when interpreting these findings. First, the study used a non-probability convenience sampling approach, and the sample may not represent the broader population of dental hygienists in Lithuania. Second, the data were self-reported and may be subject to recall and response bias. Third, the questionnaire was developed by the authors and was not formally validated, which may affect the reliability and comparability of the measurements. Fourth, patient satisfaction and treatment-related complications were reported by dental hygienists rather than assessed directly among patients. Finally, the cross-sectional design does not permit causal conclusions or objective assessment of the long-term effectiveness of whitening methods. Future studies should consider representative sampling, validated measurement instruments, direct patient-reported outcomes, and longitudinal assessment of whitening results.

STRENGTHS AND LIMITATIONS OF THE STUDY

This study provides insight into dental hygienists' perceptions of tooth whitening methods, their perceived effectiveness, patient satisfaction, contraindications, and adverse effects. An important strength is that several aspects of tooth whitening practice were explored within a single survey. The use of both descriptive and inferential statistical analyses enabled the identification of associations between selected whitening-related variables and professional perceptions.

Nevertheless, several limitations should be acknowledged. First, the findings were based on self-reported responses and may therefore be affected by recall bias and subjective interpretation. Second, the questionnaire was developed by the authors and was not formally validated, which may limit the reliability and validity of the measurements. Third, convenience sampling and voluntary participation may have introduced selection bias, as dental hygienists with a greater interest in tooth whitening may have been more likely to participate. Consequently, the sample cannot be assumed to be representative of all dental hygienists practising in Lithuania, and the findings should be interpreted with caution.

Fourth, the cross-sectional design does not allow causal relationships to be established between whitening methods and perceived outcomes. In addition, patient satisfaction and adverse effects were reported by dental hygienists rather than assessed directly among patients. Therefore, these findings reflect the perceptions and experiences reported by participating professionals rather than objectively measured patient outcomes. Finally, some analyses may have been affected by small subgroup sizes, and any category merging should be considered when interpreting the inferential results.

Future research should consider larger and more representative samples, validated questionnaires, and direct assessments of patient satisfaction and adverse effects. Longitudinal studies incorporating objective measures of tooth colour change and the durability of whitening outcomes would also help to clarify the comparative effectiveness of different whitening methods.

CONCLUSIONS

1. Combined in-office and home whitening together with LED-assisted whitening were the most frequently used whitening approaches among Lithuanian dental hygienists.
2. Home tray whitening was perceived as providing the most durable whitening outcomes and was associated with higher levels of patient satisfaction.
3. Tooth sensitivity was identified as the most common adverse effect following whitening procedures.
4. Perceived whitening effectiveness was associated with several clinical factors, including whitening technique selection, perceived tissue impact, and post-treatment sensitivity.

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