

Research Article

The familiarity and knowledge among specialists, under- and postgraduate students about photodynamic therapy

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Abstract: Objectives: This study aimed to assess the familiarity and knowledge regarding photodynamic therapy (PDT) amongst the specialists, undergraduate and postgraduate students in the academic dental institutes. Subjects and Methods: A cross-sectional questionnaire-based survey was conducted among specialists, undergraduate and postgraduate students from three dental colleges. The three-sections questionnaire was distributed online to the targeted populations. The first section of the questionnaire aimed to collect the demographics variables of the respondents, while the second and third sections were dedicated to determining the familiarity and knowledge towards PDT, respectively. Results: Out of 700 respondents, only 403 (57.6%) responded to the questionnaire with an average age of 28.4 ± 7.9 years, who were divided into 127 (31.5%) male and 276 (68.5%) female. Most respondents demonstrated an acceptable level of familiarity regarding PDT with postgraduates and specialists expressing significantly higher degree of familiarity than undergraduates. Additionally, the specialists showed a significantly higher degree of knowledge about PDT than postgraduates and undergraduates. Similarly, respondents with a longer professional career experience (>6 years) showed significantly higher knowledge than those with less years of experience. Overall, true familiarity of PDT was reported by only 25.1% of the respondents. Conclusion: Generally, respondents demonstrated average degrees of familiarity and knowledge about PDT. However, in-depth knowledge of the respondents was compromised suggesting integration of PDT topic in the dental curricula of undergraduates and postgraduates together with continuous education and training programs for dental practitioners.

Keywords: Photodynamic therapy; familiarity; education; knowledge

Introduction

In the era of modernized medical practice, photodynamic therapy (PDT) has been introduced and practiced over the last decades. It is a non-invasive technique widely used in the treatment of various cancerous lesions and other non-oncological disorders⁽¹⁻³⁾. The mode of action of PDT is based on the interaction between a photosensitizer (PS) and light of a specific wavelength in the presence of oxygen. This interaction releases cytotoxic substances, particularly singlet oxygen and other reactive agents,^(4,5) which in turn leads to the cellular death of the targeted tissues/microbes^(6,7). Nowadays, PDT is recognized in dentistry⁽⁸⁻¹¹⁾ for treating periodontal and peri-implant diseases,^(12,13) root canal disinfection,⁽¹⁴⁾ dental caries removal⁽¹⁵⁾ and non-invasive treatment of cancerous lesions⁽¹⁶⁾. Additionally, PS is characterized by

diverse modes of administration ranging from intravenous injection, oral ingestion, and topical/local application ⁽¹⁷⁾.

Although cumulative evidence supports the promising role of PDT for treating wide range of oral diseases/conditions. The application of this technique is still limited to academic settings and research even though PDT finds its way to general clinical practice mainly in developed countries ⁽¹⁸⁾. On contrary, underdeveloped and developing countries still behind in this aspect due to lack of necessary expertise and knowledge together with relatively high operating cost, and restricted access to devices, drugs and materials ⁽¹⁹⁾. While clinical applications of PDT have reached a milestone in certain medical specialties, its use in general dental practice still controversial and the evidence from ongoing academic studies not fully approved yet ^(18,20).

The full picture about insufficiencies of familiarity and knowledge of dental students, practitioners, and specialist in underdeveloped countries about PDT still cloudy. This was principally attributed to the negligence or incomplete coverage of PDT topic in dental curricula, lack of proper training programs, and availability of appropriate PDT devices/equipment and materials in the academic and health institutes which seriously hinder familiarity and knowledge of clinicians and patients regarding PDT principles and benefits ⁽²¹⁾. The need of incorporating laser-based technologies, including PDT, as a part of contemporary dental practice is constantly escalating ⁽²²⁾. We hypothesized that the level of familiarity and knowledge of PDT would differ significantly across academic levels and years of clinical experience. Therefore, this survey was conducted for assessing the familiarity and knowledge regarding PDT amongst the specialists, undergraduate and postgraduate students in the academic dental institutes.

Materials and Methods

Study design and settings

A cross-sectional, questionnaire-based survey was conducted amongst specialists, undergraduate and postgraduate students from three universities in Baghdad, Iraq. This study was conducted from December 2023 to March 2024 after obtaining the ethical approval from the Ethics Committee of the College of Dentistry, University of Baghdad (Ref .No.854). The study followed the STROBE (Strengthening the Reporting of Observational Studies in Epidemiology) guidelines for observational studies. All respondents were assured that the participation was completely anonymous, confidential, and voluntary with a complete explanation of the objective and purpose of the study in consistency with Declaration of Helsinki for human studies (2013 version). The first page of the online questionnaire fully described the aim of the study, and the respondents provided informed consent by ticking a mandatory checkbox.

Eligibility criteria

The respondents were identified via university registries, social media, and official WhatsApp lists. Those included 4th and 5th year undergraduate dental students, postgraduate students enrolled in MSc and PhD programs, licensed specialists affiliated with any academic institute in Baghdad city. Preclinical dental students, dentists without academic affiliation, duplicate responses, and questionnaires with >10% missing responses were excluded from this study.

The questionnaire components and validation

The questionnaire used for this survey was adapted, without translation, from a previous study⁽²³⁾. First, the questionnaire was distributed to the targeted populations using Google forms. This questionnaire was dedicated to assessing the familiarity and knowledge towards PDT and its practice in dentistry. The questionnaire consisted of three main sections with 11 items and the response was either closed end (yes/no) or Likert-scale style. The first section of the questionnaire aimed to collect the socio-demographic details of respondents including age, sex, academic degree, professional experience in years. The second section was dedicated to assessing the familiarity of the respondents to PDT which focused on to which extent the respondents are aware about this technique and whether it is a modern and reliable substitute for the conventional treatments. The response to these questions was "YES" or "No" where positive response received score "1" and negative response scores "0". The responses to this section were averaged for each participant and used for comparisons. This was followed by the third section which was 4-points Likert-based response to determine the knowledge and background about PDT. It included the following questions: (i) PS plays an integral role in the process. (ii) Laser of the appropriate wavelength is not required in the technique (iii) PDT does not enable selective destruction (iv) Oxygen is necessary and needs to be dissolved in the cells (v) PS should be soluble enough in the tissue of the body. The responses to these items were "Strongly disagree", "Disagree", "Agree", "Strongly agree" which received scores from 0 to 4. Frequencies of responses for each respondents were used for statistical analysis.

The contents of the questionnaire were assessed for validity by a panel of 6 experts who rated each item on a 4 points scale. Content Validity Index (CVI) was calculated any item with CVI <0.75 was discarded or revised until the final reported CVI value was 0.89. This was followed by a pilot testing by 30 participants, not included in the final analysis, to assess response time and item performance. Internal consistency was assessed which yielded Cronbach's α of 0.86 and further assessed by test-retest reliability by 20 respondents over two weeks using which yielded intraclass correlation coefficient (ICC) of 0.92. The questionnaire form was distributed in English language without translation.

Study outcomes

The primary outcome of this survey was the proportion of respondents exhibiting $\geq 50\%$ level of knowledge about PDT. Secondary outcomes include the proportion of respondents reporting familiarity with PDT, and intergroup differences stratified according to academic level, sex, and years of professional experience.

Sample size calculation and sampling strategy

The required number of respondents joining this survey was calculated as previously described⁽²⁴⁾ by using the following formula:

$$\text{Sample size} = Z^2 \cdot p \cdot (1-p) / e^2 / 1 + (Z^2 \cdot p \cdot (1-p) / e^2 \cdot N)$$

Where p represented prevalence of PDT knowledge, which was assumed 0.50 (due to lack of previous data about this topic in Iraqi population), z is z score which is 1.96 for 95% confidence interval, e is the

error margin (5%), and N is the population size which was estimated by 10000. The calculated sample size was 382 respondents which was rounded to 422 after accounting for 10% possible incomplete responses. Sample size was calculated using Epi Info v.7.2 (CDC, Atlanta, GA, USA). A non-probability convenience sampling method was followed for distributing the online form of the questionnaire. The 700 eligible candidates received the link via emails and official WhatsApp or Telegram groups, two reminders were sent over two weeks.

Statistical analysis

Continuous variables were represented as mean and standard deviation while categorical data was expressed as frequency (N) and percent (%) with 95% confidence interval (CI). Normality distribution of continuous data was assessed by Shapiro-Wilk test which indicated their nonparametric nature. Accordingly, two groups comparison was performed by using Mann-Whitney test, while Kruskal Wallis test with *post-hoc* Dunn–Bonferroni correction was used for multi-group comparison. Chi square test was used to assess statistical differences between categorical variables. Age of the respondents and years of professional experience were dichotomized according to their means. Incomplete questionnaires were considered as missing data and excluded from final analysis. Effect sizes for Chi square was expressed using Phi (ϕ) test, rank-biserial correlation (r) for Mann-Whitney test, and Eta squared (η^2) for Kruskal Wallis test. Statistical differences were accounted significant when p value was less than 5%. All statistical analyses were performed using GraphPad Prism (version 9, USA) software.

Results

A total of 700 candidates from different academic institutes were invited. The overall response rate to this survey was 57.6% (n= 403) of the respondents who were included in the final analysis (Figure 1).

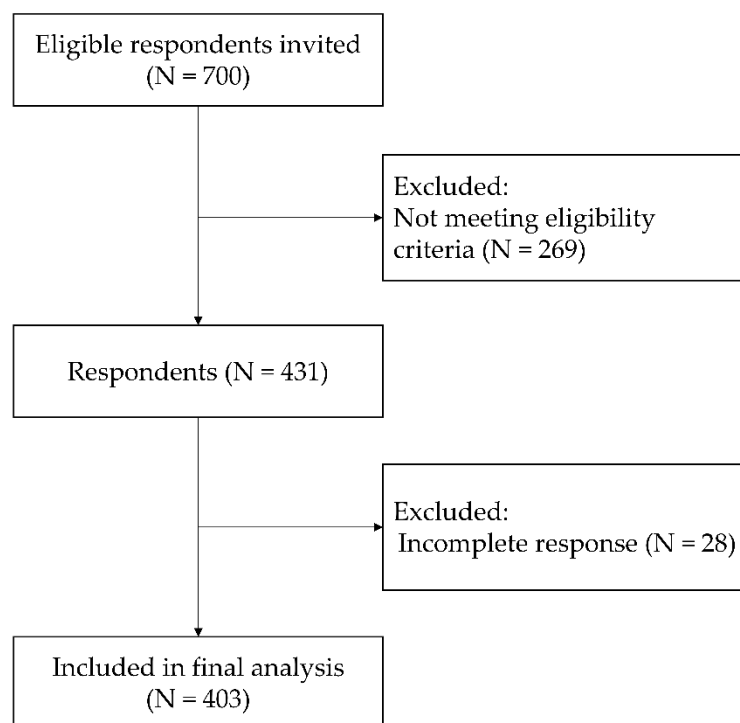


Figure 1: STROBE flowchart of the study

Based on the sex, the respondents were divided into (127) male and (276) female. According to academic degree, the sample was subdivided into undergraduates, postgraduates, and specialists comprising 153 (38%), 144 (35.7%), and 106 (26.3%) of the sample, respectively (Table 1). The average age and years of professional experience are shown in (Table 1).

Table 1: Basic demographic variables of the study population.

Variables	
Sex	
Male	127 (31.5%)
Female	276 (68.5%)
Academic degree	
Undergraduate student	153 (38.0%)
Postgraduate student	144 (35.7%)
Specialist	106 (26.3%)
Age (years)[§]	28.4 ±7.9
Professional experience (years)[§]	8.8 ±7.1

[§]Mean ±SD

Summary of responses to the questionnaire are shown in (Table 2). For items 1 and 2 which were dedicated to measure the familiarity about PDT, 64.2% of the respondents responded positively about the safety and reliability of PDT as modern approach to treat or adjunct conventional treatments. However, only 25.1% reported that they are familiar with PDT. The responses to items 3 to 7, dedicated to measure the knowledge about PDT, were greatly varied. While 312 (77.6%) of the respondents confirmed the integral role of PS, only 62 (15.4%) respondents expressed positive response about the importance of using specific laser wavelength for each application. Additionally, majority of respondents expressed negative knowledge about the selective destruction of PDT. Other responses were good regarding the role of oxygen and solubility of PS in the tissue during this process.

Table 2: Distribution of positive responses to the study questionnaire.

Items	Positive response
Are you familiar with photodynamic therapy (PDT)?	101 (25.1%)
Do you believe PDT is one of the modern, safe, and reliable alternative or adjuncts to conventional treatment?	258 (64.2%)
Photosensitizer plays an integral role in the process.	312 (77.6%)
Laser of the appropriate wavelength is not required in the technique.	62 (15.4%)
PDT does not enable selective destruction.	109 (27.1%)
Oxygen is necessary that needs to be dissolved in the cells.	280 (69.7%)
Photosensitizer should be soluble enough in the tissue of the body.	267 (66.4%)

The degree of familiarity towards the use of PDT were measured by comparing total scores of each respondent according to different variables including sex, age, academic degree, and years of professional experience (Figure 2). No significant differences were detected between these variables except for academic degree. The scores of postgraduates and specialists were significantly higher ($p < 0.001$) than

undergraduates. Further analysis of effect sizes of sex ($r = -0.079$), age ($r = -0.037$), and professional experience ($r = -0.061$) were all negligible ($r < 0.1$), indicating lack of meaningful associations with PDT familiarity. However, the magnitude of academic degree demonstrated a medium effect ($\eta^2 = 0.063$), explaining about 6.3% of the variance in familiarity with PDT (Figure 2).

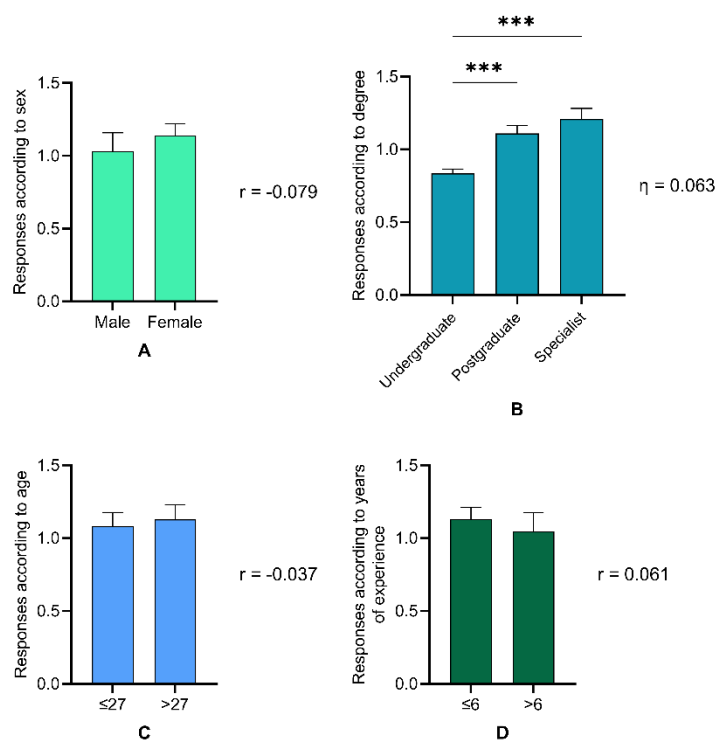


Figure 2: Degree of familiarity to the use of photodynamic therapy (PDT) according to different variables. A) sex, B) academic degree, C) age, and D) years of professional experience. No significant differences were detected except for the academic degree in which both postgraduates and specialists showed higher degree of familiarity in comparison to undergraduates. Negligible association between sex, age, and professional experience with familiarity of PDT, but academic degree showed medium effect. Two groups comparison was performed by Mann-Whitney test with effect size by rank-biserial correlation (r) and Kruskal Wallis test and effect size by η^2 for multi-group comparisons. *** significant difference at $p < 0.05$

The degree of knowledge was also measured according to the above-mentioned variables based on the 50% threshold of correct answers (Figure 3). The specialists showed significantly higher degree of knowledge about PDT than postgraduates and undergraduates. Similarly, respondents with a longer professional career experience (> 6 years) showed significantly higher knowledge than those with less years of experience. No significant differences were detected in knowledge about PDT according to sex and age of the respondents. Effect sizes for specialists ($\phi = 0.163$) and those with longer years of professional experience ($\phi = 0.109$) showed significantly higher knowledge of PDT; however, both associations exhibited small magnitudes, accounting for (ϕ^2) 2.66% and 1.18% of the variance in knowledge classification, respectively. No practically meaningful associations were observed for sex ($\phi = 0.059$) or age ($\phi = 0.024$) (Figure 3).

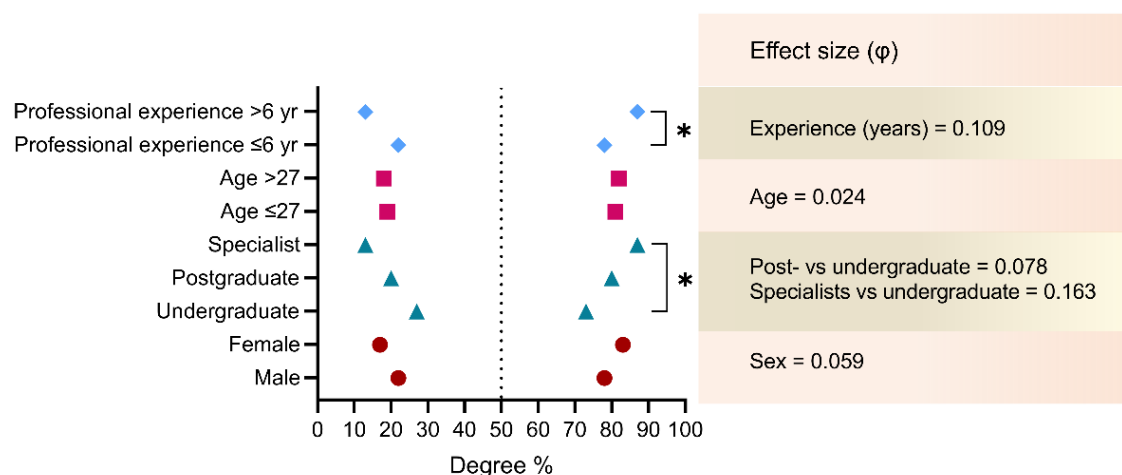


Figure 3.: Degree of knowledge about photodynamic therapy (PDT). The threshold of is correct answers 50%. Academic degree and years of professional experience were significantly associated with PDT knowledge with small effect size (Phi ϕ). * Significant difference at $p < 0.05$ using Chi square test.

Discussion

The results demonstrated that the specialists and those with longer clinical experience have significantly higher knowledge and familiarity about PDT. The knowledge among respondents was generally moderate with deficiency in knowledge about in-depth technical aspects of PDT that was confined to about 25% of the respondents only. This study aimed to determine the familiarity and knowledge of specialists, undergraduate and postgraduate students about PDT in dentistry. The results indicated that the higher degree holders were more familiar about this technique. The degree and experience years had significant impact on the knowledge related to PDT.

The demographic data showed a high number of female respondents (68.5%) in the present study as compared to males (31.5%). This was in consistency with a previous study which also showed that the number of females in dental institutes is higher than male ⁽²³⁾. Questions exploring the degree of familiarity about PDT showed significant difference in scores between postgraduates and specialists than undergraduates. This could be attributed to the minimal or lack of resources for PDT and laser therapy training during undergraduate courses and pre-clinical years which is not considered as an essential treatment especially in the developed and underdeveloped countries ⁽¹⁹⁾. Background knowledge obtained during study years or courses showed a significant impact on the degree of awareness and quality of researches output together with accuracy in interpretation of clinical results of PDT ⁽¹⁾.

Only 25.1% of the respondents expressed their familiarity with PDT which was not consistent with responses to most of the question related to the knowledge about this technique. These results were opposite to these reported by a similar study that was conducted in another university ⁽²³⁾. These differences could be explained to which extent PDT was covered by the dental curricula and availability of the PDT-related devices in the health institutes and training centers of each country. However, the latter study and our survey agreed on the need of introducing PDT into undergraduate dental curricula. Questions related to the integral role of the PS and oxygen for PDT received the highest positive responses. The answers to this set of questions could be directly comprehended as a common sense by the respondents or this

information were acquired as a general knowledge during study years or from other resources. This notion was supported by lower response rates to other in-depth questions that focused on choosing the appropriate wavelength, the need of oxygen solubility, and selective destructive nature of PDT. These results were aligned with a previous study which showed almost a similar pattern of responses ⁽²³⁾. These results highlighted a general gap in knowledge about PDT among dental students and practitioners as this topic is not sufficiently covered by the dental curricula or lack of training and handling, these issues were emphasized by several previous studies ^(1,21,23,25).

Ample number of respondents expressed their belief and enthusiasm for introducing PDT as a modern and reliable technique for treating oral diseases. The concept of using light and PS as non-invasive with a minimal discomfort to the patient and can be administrated with variety of methods are attractive reasons for most of dental practitioners and the patients ^(17,26).

Inferential analyses for data of this study demonstrated that the degree of knowledge of PDT among the specialists was significantly higher than postgraduates and undergraduates. Similarly, respondents with a longer professional career experience (>6 years) showed significantly higher knowledge than those with less years of experience. Consistently, Helmi ⁽²¹⁾ reported similar results which indicated that increased experience and education were associated with a higher knowledge about the application of PDT in dentistry. These results could be explained by that those with higher academic degrees or years of clinical experience are engaged more to research studies and activities related to the implementation of PDT in the dental practice such as continuing education, conference attendance, and other scientific events.

Spread the knowledge about the importance of PDT and its applications is crucial; however, certain obstacles should be addressed first including the cost of the devices/materials used in this technique and the need of qualified training team. These factors were among the limitations of this study that need further inspection. Governmental support can greatly bridge the gaps for dental practitioners and the best example is a government-funded national program that was conducted in Brazil ⁽¹⁸⁾. This program provided theoretical and practical training, access to materials/equipment that greatly reduced the cost for the participants. Additionally, this promising program created basis for a collaboration network between 10 countries in Latin America that significantly established PDT as well-recognized and treatment of choice for many diseases. Other aspects that were not investigated by this survey included self-reported rating of knowledge and feedback about how the dental curricula/programs could be improved. Other limitations associated with the current survey include limited generalizability since it was conducted in one city, lack of validation between self-reported knowledge and objective clinical performance, and possible introduction of self-selection bias. However, this study included relatively large and diverse sample which reflected a glimpse about the level of PDT familiarity and knowledge among the targeted population.

Conclusion

Generally, respondents demonstrated average degrees of familiarity and knowledge about PDT. However, their in-depth knowledge about technical aspects was compromised suggesting the need to introduce PDT topic in the dental curricula of undergraduates and postgraduates together with continuous education and training programs for dental practitioners.

Conflict of interest

The authors declared no potential conflicts of interest with respect to the research, authorship, and/or publication of this article.

Author contributions

Z.T.A. and N.K.I. were responsible for design and conceptualization. Z.T.A. and N.K.I. recruited data. A.R.A. conducted the statistical analysis. Z.T.A. wrote the first draft. A.R.A. and N.K.I. critically revised the manuscript. N.K.I. supervised the findings of this work. All authors discussed the results and contributed to the final manuscript. The research, analysis, and manuscript were approved by all authors.

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Ethics approval statement

This study was approved by the Ethics Committee, College of Dentistry, University of Baghdad (Reference No. 854, Project No. 854623, Date: 3-12-2023).

Patient consent statement

All respondents signed the informed consent, and they were fully informed about the aims and nature of the study.

Data availability statement

The data that support the findings of this study are available from the corresponding author upon reasonable request.

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التعريف والمعرفة بين المتخصصين وطلاب الدراسات العليا والجامعية حول العلاج الضوئي الديناميكي

ندى كاظم عمران, زهراء طالب عبد, غزوان عدنان, ضحى حسين, مناف طاهر آغا

المستخلص:

هدفت هذه الدراسة إلى تقييم التعريف والمعرفة فيما يتعلق بالعلاج الضوئي الديناميكي بين الاختصاصيين وطلاب الدراسات العليا والجامعية في مؤسسات طب الأسنان الأكاديمية تم إجراء مسح مقطعي قائم على الاستبيان بين الاختصاصيين وطلاب الدراسات العليا والطلاب من كليات طب الأسنان المختلفة. وقد تم توزيع الاستبانة المكونة من ثلاثة أقسام إلكترونيًا على الأشخاص المستهدفين. يهدف القسم الأول من الاستبانة إلى جمع المتغيرات الديموغرافية للمشاركين، بينما خصص القسم الثاني والثالث لتحديد مدى المعرفة تجاه العلاج الضوئي الديناميكي، على التوالي. من بين 700 مشارك، استجاب 403 فقط (57.6%) للاستبيان بمتوسط عمر 28.4 ± 7.9 سنة، وتم تقسيمهم إلى 127 (31.5%) من الذكور و 276 (68.5%) من الإناث. أظهر معظم المشاركين مستوى مقبولًا من الإلمام فيما يتعلق بالعلاج الضوئي الديناميكي من طلاب الدراسات العليا والاختصاصيين الذين أظهروا درجة أعلى بكثير من الإلمام مقارنة بالطلاب الجامعيين. بالإضافة إلى ذلك، أظهر الاختصاصيين درجة أعلى بكثير من المعرفة بالعلاج الضوئي الديناميكي مقارنة بطلاب الدراسات العليا والطلاب الجامعيين. وبالمثل، أظهر المشاركون ذوو الخبرة المهنية الطويلة (> 6 سنوات) معرفة أعلى بكثير من أولئك الذين لديهم سنوات خبرة أقل. بشكل عام، أظهرت استجابات المشاركين درجات متوسطة من المعرفة والإلمام بالعلاج الضوئي الديناميكي. ومع ذلك، تم اختراق المعرفة المتعمقة للمشاركين مما يشير إلى الحاجة إلى إدخال موضوع العلاج الضوئي الديناميكي في مناهج طب الأسنان للطلاب الجامعيين وطلاب الدراسات العليا جنبًا إلى جنب مع برامج التعليم والتدريب المستمر لممارسي طب الأسنان.