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ASSESSMENT OF KNOWLEDGE, ATTITUDE AND PRACTICES REGARDING GREEN ECO-FRIENDLY DENTISTRY AMONG DENTISTS: A CROSS-SECTIONAL STUDY

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ABSTRACT

Background: Green dentistry is a new concept that aims to implement the principles of reducing, recycling, and reusing to preserve the environment and help in reducing global warming. Dental profession is considered one of the sources of increased waste. The knowledge of health professionals, including dentists, regarding green dentistry is variable.

Aim: Is to assess the knowledge, attitude, and practices of dentists regarding green eco-friendly dentistry.

Participants and Methods: An online google form self-administered questionnaire adopted by Nagarale et al., 2022 was used to assess the knowledge, attitude, and practices of dentists regarding green eco-friendly dentistry. The results of the questionnaire were obtained, statistically analyzed and scores for the different questions' responses were obtained.

Results: Answers were obtained from 302 participants. More than half (187, 61.9%) had poor knowledge score. The mean participants' knowledge score was 4.8±2.2 (range 0-12). Good-fair attitude was reported by the majority (301, 99.67%). The mean participants' attitude score was 17.8±2.06 (range 11-25). While there were bad practices (246, 81.5%), with mean practice score as 2.3±1.3 (range 0-7).

Conclusion: Participants had poor knowledge, good-fair attitudes, and bad practices regarding green dentistry concepts. Consequently, more awareness for dentists is needed.

KEYWORDS: green dentistry, dentist, eco-friendly dentistry, knowledge, attitude, practice

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INTRODUCTION

Environmental changes happening worldwide including global warming, fresh water sparsity, extinction of some species, and depletion of resources are threatening the human race (Malhi et al., 2020). Environmentalism is a social movement which aims to implement systems for natural resources and ecosystem preservation through political practices. The dental profession is one of the sources (although minor) of domestic, pharmaceutical, toxic and chemical waste (Danaei et al., 2014).

Green as a color is the combination of blue and yellow. It has always denoted renewal, growth, and hope as it is a relaxing color enhancing vision, stability, and endurance. In eastern cultures it conveys regeneration and fertility. It is used to denote safety in advertising drugs and other products (Adams & Helfand, 2017). Green dentistry is a concept and tactic to lessen environmental problems from dental work and at the same time create an environment that cares for patients with cost and time reduction. This concept mainly relies on the model of four R's – Reduce, Rethink, Recycle and Re-use (Vanka et al., 2019).

Green dentistry mainly aims to conserving energy and water, waste reduction, pollution reduction, using products that are non-toxic, abolition of toxins that are hazardous in addition to the encouragement of green products (Rastogi et al., 2014). The idea does not mean only to be environment friendly but is also a modernization to save time and money (Sachdeva et al., 2018) and incorporating innovations focusing on wellbeing and consolidative practices (Keerikkadu et al., 2023).

Conserving energy can be obtained by minimizing the use of electricity and radiation, use of motion sensors, and using LED devices and bulbs. Water conservation can be obtained by turning off water and using water tap sensors in addition to the use of waterless hand sanitizers. Also, sterilization devices are to be operated when fully loaded and regularly maintained and serviced (Sachdeva et al., 2018).

The most common sources of waste production and pollution in the dental office include mainly: the use of disposable stuffs and poisonous disinfectants, suction or saliva ejector systems, the use of mercury in materials as amalgam, and the use of conventional radiographic techniques.

Disposable items including cups, gloves, disposable head rest covers, suction tips, and gowns can be replaced. The use of reusable cups, metal suction tips, cloth head rest covers, patient bibs, and gowns can be plausible alternatives. Using steam sterilizers can help reduce the use of chemicals. Regarding saliva ejector systems, the use of a dry vacuum system may help reducing the excessive amounts of water wasted in the conventional dental vacuum systems (Anderson, 1999; Hiltz, 2007).

Dental amalgam was used for more than a century and is a source of silver, tin, and lead that produces environment pollution. Mercury enters the soil, and water is converted by bacteria to methyl mercury which is a neurotoxin causing damage to human's lung, brain and kidneys. The use of alternatives as composite and glass ionomer, in addition to recycling amalgam waste and the use of amalgam separators are eco-friendly approaches (Chin et al., 2000).

Conventional radiographic techniques are a source of silver pollutants (unused fixers and films) and lead pollutants (film packets, lead shields and aprons). The use of digital imaging is a feasible alternative, in addition to collecting and recycling lead waste and scrap metal from films together with developer dilution and filter used fixer (Sachdeva et al., 2018).

Among the hi tech innovations that can be implemented are the digitization of imaging systems, CAD/CAM use, digital communication systems

with patients, marketing, charting and recording as well as scheduling and billing (Rathakrishnan & Priyadarhini, 2017).

Although going green is a worldwide movement, there is a lack of inclusion of the topic in dental education. Thus, the aim of this study is to assess the knowledge, attitude, and practice of a group of dentists regarding green eco-friendly dentistry.

PARTICIPANTS AND METHODS

Study design

This study is an exploratory cross-sectional study that was executed among a group of dentists in Egypt. It was carried out following the Reporting Results of Internet E-Surveys guidelines for the online survey (Eysenbach, 2004) and the Strengthening the Reporting of Observational Studies in Epidemiology (STROBE) Statement guidelines for reporting observational studies (Cuschieri, 2019).

This self-administered questionnaire adopted from (Nagarale et al., 2022) was used to assess the knowledge, attitude, and practices of a group of dentists regarding green eco-friendly Dentistry. This study was registered on clinical trials.gov with ID number NCT06564454.

Participants

Eligibility criteria

Inclusion criteria:

Graduated dentists.

Dentists graduated from Egyptian universities.

Exclusion criteria:

Refusal of participation.

Methods of selection

Dentists were invited to participate in the study through different social media platforms.

Sampling technique

Technique used for sampling is consecutive convenience. We used a "self-selection web-based questionnaire". The questionnaire link was shared among groups on Facebook, (commonly used social media platform in Egypt). Permission was obtained from Facebook administrators to share the link among their groups. Also, the link was shared on WhatsApp groups and messenger. The link was posted with an inspiring declaration including its aim and the investigator's contact information. The questionnaire had public access, so that any dental graduate can fill it.

Sample size:

We assumed that the population is 100000 with 50% of the population does not know the knowledge, thus a sample size of 270 participants will be sufficient with confidence level 90% with effect size 1 using Epi-info calculator.

Data collection technique

Data collection method was in an online format. A Google form was created, and participants were invited to fill and submit it. The questionnaire consisted of the following:

- Socio-demographic characteristics: Age, gender, place of work, qualifications (highest degree of education), and years of experience.
- The knowledge of study participants regarding green dentistry consists of a total of 12 items.
- The attitudes of study participants consist of five closed-ended questions.
- The practice consists of 7 items, assesses green dentistry related practice.

Ethical Considerations:

This is an anonymous survey, and voluntary participation was addressed to the participants. A paragraph tackling the aim of the study, voluntary involvement and confidentiality was written at

the beginning of the questionnaire. The research protocol was reviewed and granted ethical approval (Approval number 64-7-24) by the Research Ethics Committee, Faculty of Dentistry, Cairo University. Measures were implemented to safeguard participants' privacy and minimize any potential discomfort associated with participation. Participants' names or any personal information was not obtained or linked to the research by any means. The participant was allowed to withdraw at any time or refuse to complete the questionnaire. Data collection procedures were preserved with confidentiality following the Helsinki Declarations on biomedical ethics (Carlson et al., 2004).

Statistical analysis

Data entries were carried out using SPSS (Statistical Package for Social Science) version 28.0 (IBM, SPSS, USA). Categorical variables were expressed in numbers and percentages. Comparisons were performed by Chi-square. Quantitative variables were examined for normality and were expressed using mean, and standard deviation; the t- test and ANOVA test were used for comparison. All tests were two tailed and *p* value <0.05 was considered statistically significant.

Regarding knowledge about green dentistry, the points for questions distributed as follow (No= 0, Yes=1), the total score was 12, the range of scores was 0-12. Participants with scores of 9-12 (> 75%) were considered "good", those with scores of 6-8 (>50%) were considered "fair", and those with scores of 1-5 (<50%) were considered "poor".

For attitude section, the highest score was 5 for strongly agree and 1 for strongly disagree (except for reversed questions; 1 for strongly agree and 5 for strongly disagree). The total attitude score was 25, and the range of scores was 5–25. Participants with scores of 19-25 (> 75%) were considered "good", those with scores of 13-18 (> 50%) were considered "fair", and those with scores of 5-12 (50%) were considered "poor".

Regarding practices about green dentistry, the points for questions distributed as follow (good practice=1, bad practice=0). The total score is 7, and the range of scores is 0–7. Participants with a score of 4-7 (>50%) were classified as " good practice " of green dentistry tools, those with a score of 0-3 (<50%) as "bad practice ". A higher score means good practice, while a lower score means bad practice (Bloom, 1968).

RESULTS

Study participants' demographic characteristics are shown in table 1. The total number of returned completed questionnaires were 302. Participant's mean age was 35.2±7.4 years (range 18-73 years), 239 (79.1%) being female, 111 (36.8%) had finished their PhD, while most of them (57.6%) working at the governmental sector, and 125 (41.4%) had 10 to less than 20 years of experience.

TABLE (1) Basic participants' demographic characteristics (n=302).

Demographics characteristics	**No. %**
Gender	
Male	63 (20.9)
Female	239 (79.1)
Age (mean± SD) in years	35.2±7.4
Qualifications	
BDs	96 (31.8)
MDs	95 (31.5)
PhD	111 (36.8)
Place of work	
Governmental sector	174 (57.6)
Private sector	116 (38.4)
Other *	10 (3.3)
Non-employed	2 (0.66)
Years of experience	
1-5 years	76 (25.2)
5- < 10 years	49 (16.2)
10- < 20 years	125 (41.4)
≥20 years	52 (17.2)

: Other (National Research Center and interns)

Knowledge of participants:

Questions used for assessment of knowledge and participants' responses correlated to the correct answers are presented in table (2). We found that, only 39 (12.9%) of the participants were aware of the programs endorsed by Eco Dentistry Association (EDA). However, most of the participants, 204 (67.5%) have correct knowledge about innovations employed in green dentistry.

TABLE (2) Distribution of knowledge assessment questions regarding green dentistry (n=302).

Knowledge questions	Correct answer n (%)	Wrong answer n (%)
Familiar with the notion behind Eco-friendly Dentistry	156 (51.7)	146 (48.3)
Dentists contribute to 70% of total mercury load entering wastewater treatment facilities	96 (31.8)	206 (68.2)
Nearly 1.7 billion instruments sterilization pouches are dumped into landfills yearly	59 (19.5)	243 (80.5)
Aware that worn out dental instruments can be recycled	138 (45.7)	164 (54.3)
Aware of biodegradable electronic supplies	96 (31.8)	206 (68.2)
Aware of the programs endorsed by Eco Dentistry Association (EDA)	39 (12.9)	263 (87.1)
Eco-friendly amalgam management practice	60 (19.9)	242 (80.1)
Sustainable dental hygiene products	160 (53)	142 (47)
Eco-friendly type of flooring	129 (42.7)	173 (57.3)
Green infection control practices	152 (50.3)	150 (49.7)
Innovations employed in green dentistry	204 (67.5)	98 (32.5)
Methods would be effective in reducing the dental industry's carbon footprint	176 (58.3)	126 (41.7)
Total knowledge score		
Good	18 (6)	
Fair	97 (32.1)	
Poor	187 (61.9)	
mean± SD*	4.8± 2.2	

**** SD: Standard Deviation.***

Also, around half of participants provided correct answers about sustainable dental hygiene products (53%), green infection control practices (50.3%), and methods of reducing the dental industry's carbon footprint (58.3%).

Overall knowledge: More than half (187, 61.9%) had poor knowledge score. The mean participants' knowledge score was 4.8±2.2 (range 0-12).

The distribution of knowledge about green dentistry is presented in table (3)

TABLE (3) Knowledge about green dentistry among participants (n=302).

Knowledge questions	n (%)
Are you familiar with the notion behind Eco-friendly Dentistry?	
Yes	156 (51.7)
No	146 (48.3)
Did you know that dentists contribute to 70% of total mercury load entering wastewater treatment facilities?	
Yes	96 (31.8)
No	206 (68.2)
Did you know that nearly 1.7 billion instruments sterilization pouches are dumped into landfills yearly?	
Yes	59 (19.5)
No	243 (80.5)
Are you aware that worn out dental instruments can be recycled?	
Yes	138 (45.7)
No	164 (54.3)
Are you aware of biodegradable electronic supplies?	
Yes	96 (31.8)
No	206 (68.2)
Are you aware of the programs endorsed by Eco Dentistry Association (EDA)?	
Yes	39 (12.9)
No	263 (87.1)
Which of the following is an eco-friendly amalgam management practice?	
All of the above	53 (17.5)
Disregard of alternatives to amalgam filling	42 (13.9)
Keeping unused amalgam in poorly-sealed containers	14 (4.6)
None of the above	133 (44.0)
Use of amalgam separator	60 (19.9)

Knowledge questions	n (%)
Which of the following is a sustainable dental hygiene product?	
All of the above	79 (26.2)
Bamboo toothbrush	160 (53.0)
Copper tongue cleaner	11 (3.6)
None of the above	26 (8.6)
Nylon dental floss	26 (8.6)
Which of the following is an eco-friendly type of flooring?	
All of the above	36 (11.9)
Bamboo	129 (42.7)
Marble	63 (20.9)
None of the above	34 (11.3)
Vinyl	40 (13.2)
Which of the following is a green infection control practice?	
All of the above	56 (18.5)
None of the above	54 (17.9)
Use of HDPE (High Density Poly Ethylene) plastic disinfectant pump spray bottles	18 (6.0)
Use of non-biodegradable disinfectants	22 (7.3)
Use of washable cloth lab coats rather than disposable ones	152 (50.3)
Which of the following is an innovation employed in green dentistry?	
All of the above	204 (67.5)
CAD/CAM system	10 (3.3)
Digital imaging system	22 (7.3)
Digital patient charting, scheduling, billing and records	31 (10.3)
None of the above	19 (6.3)
Steam sterilizers	16 (5.3)
Which of the following methods would be effective in reducing the dental industry's carbon footprint?	
All of the above	176 (58.3)
Combining visits for family members	15 (5.0)
Encouraging cycle to work schemes or carpooling for staff	20 (6.6)
Implementing telemedicine and teleconferencing for patients	33 (10.9)
None of the above	37 (12.3)
Reducing appointment frequency based on patient risk	21 (7.0)

Attitude of participants

Most participants showed a positive attitude toward green dentistry. Most of them considered practicing sustainable dentistry an ethical duty, felt the need for educating clinicians regarding green practices formally, and disagreed about eco-friendly practices reducing work efficiency as shown in table (4). Overall, good-fair attitude was reported by the majority (301, 99.67%). The mean participants' attitude score was 17.8±2.06 (range 11-25).

Practices of participants:

As displayed in table (5), majority, 245 (81.1%) of the enrolled participants used green dentistry coping methods for patients' records. Many use eco-friendly dental hygiene products and provide their patients with advice to use the same (172, 57%), however, few of them (33, 10.9%) practice energy management in their clinics. While most of them had bad practices (246, 81.5%), with mean practice score as 2.3±1.3 (range 0-7).

The distribution of practice about green dentistry is presented in table (6).

A comparison between green dentistry-related knowledge and attitude scores and the sociodemographic characteristics revealed nonsignificant differences regarding age, gender, qualification, place of work, and years of experience. Regarding practices, the same nonsignificant differences were revealed except for gender; where females had bad practices than males, as displayed in table (7).

A mild positive correlation found between attitude and age (r=0.150). Females had higher knowledge and attitude scores than males, however, males had higher practice scores than females. Also, dentists with PhD showed higher attitude scores than with BDs and MDs. KAP scores did not show significant differences regarding place of work and years of experience, as displayed in table (8).

TABLE (4) Distribution of attitude assessment questions regarding green dentistry (n=302).

Attitude questions	Strongly agree	Agree	Neutral	Disagree	Strongly disagree
With the overwhelming evidence of global climate changes, do you consider it an ethical duty to practice sustainable dentistry?	127 (42.1)	103 (34.1)	64 (21.1)	7 (2.3)	1 (0.3)
In your opinion, would eco-friendly practices lead to more patients visiting your clinic?	36 (11.9)	100 (33.1)	138 (45.7)	25 (8.3)	3 (1.0)
In your opinion, would eco-friendly practices reduce your work efficiency?	12 (4.0)	25 (8.3)	92 (30.5)	141 (46.7)	32 (10.6)
Do you think there is a need for formally educating clinicians regarding green practices?	147 (48.7)	127 (42.1)	24 (7.9)	3 (1.0)	1 (0.3)
Do you think that shifting to green practice would be more economical to dentists, require minimal resources and no additional cost of basic infrastructure?	68 (22.5)	125 (41.4)	67 (22.2)	37 (12.3)	5 (1.7)
Overall Attitude score					
Good			111 (36.7)		
Fair			190 (62.9)		
Poor			1 (0.33)		
mean± SD*			17.8± 2.06		

**** SD: Standard Deviation.***

TABLE (5) Distribution of practice assessment questions regarding green dentistry (n=302).

Practice questions	Correct answer/ good practice n (%)	Wrong answer/ bad practice n (%)
Turn off the water while lathering, while washing hands	60 (19.9)	242 (80.1)
Energy management practices followed in your clinic	33 (10.9)	269 (89.1)
Paper waste management practices followed in your clinic	53 (17.5)	249 (82.5)
Eco-friendly items use instead of disposable ones	49 (16.2)	253 (83.8)
Use any eco-friendly dental hygiene products and advise your patients to use the same	172 (57)	130 (43)
Method of maintaining patient records	245 (81.1)	57 (18.9)
Type of personal protection equipment use	92 (30.5)	210 (69.5)
Total practice score		
Good	56 (18.5)	
Bad	246 (81.5)	
mean± SD*	2.3± 1.3	

**** SD: Standard Deviation.***

TABLE (6) Practice about green dentistry among participants (n=302).

Practice questions	n (%)
While washing hands, do you turn off the water while lathering?	
Always	60 (19.9)
Often	86 (28.5)
Rarely	56 (18.5)
Sometimes	100 (33.1)
What are the energy management practices followed in your clinic?	
All of the above	33 (10.9)
None of the above	43 (14.2)
Use of LED light bulbs	212 (70.2)
Use of renewable sources of energy (wind & solar)	14 (4.6)
What are the paper waste management practices followed in your clinic?	
All of the above	53 (17.5)
Donate old magazines and dental books to libraries or community centers	61 (20.2)
None of the above	142 (47)
Recycle dental office waste	19 (6.3)
Use of recycled paper products	27 (8.9)
Which of the following eco-friendly items do you use instead of disposable ones? (more than one answer can be chosen)	
Cloth drape, head cap and arm rest covers.	50 (16.5)
Reusable glass/metal cups and metal suction tips.	33 (10.9)
Reusable metal air/water syringe.	156 (51.6)
All of the above	53 (17.5)
None of the above	57 (18.8)
Do you use any eco-friendly dental hygiene products and would you advise your patients to use the same?	
Yes	172 (57)
No	130 (43)
What is your preferred method of maintaining patient records?	
Digital records	245 (81.1)
On paper records	57 (18.9)
What type of personal protection equipment do you use?	
Disposable	210 (69.5)
Reusable	92 (30.5)

TABLE (7) Relationship between the distribution of knowledge, attitude and practice scores regarding green dentistry and demographic characteristics.

Demographic characteristics	Knowledge grade			Attitude			Practice grade		
	Good-fair (n=115)	Poor (n=187)	*p* value	Good-fair (n=301)	Poor (n=1)	*p* value	Good (n=56)	Bad (n=246)	*p* value
Age	35.4±7.9	35.06±7.05	0.713 [a]	35.2±7.4	35±0.0	0.980 [a]	34.6±7.4	35.3±7.4	0.560 [a]
Gender									
Male	18 (28.6)	45 (71.4)	0.081 [b]	62 (98.4)	1 (1.6)	0.209 [c]	18(28.6)	45 (71.4)	**0.021** [b]
Female	97 (40.6)	142 (59.4)		239(100)	0 (0)		38(15.9)	201(84.1)	
Qualifications									
BDs	40 (41.7)	56 (58.3)		96 (100)	0 (0)		19(19.8)	77 (80.2)	
MDs	29 (30.5)	66 (69.5)	0.187 [b]	94 (98.9)	1 (1.1)	0.335 [b]	19 (20)	76 (80)	0.730 [b]
PhD	46 (41.4)	65 (58.6)		111(100)	0 (0)		18(16.2)	93 (83.8)	
Place of work									
Governmental sector	75 (43.1)	99 (56.9)		173(99.4)	1 (0.6)		35 (20.1)	139(79.9)	
Private sector	37 (31.6)	80 (68.4)	0.155 [b]	116 (100)	0 (0)	0.701 [b]	20 (17.1)	97 (82.9)	0.745 [b]
Other	3 (33.3)	6 (66.7)		9 (100)	0 (0)		1 (11.1)	8 (88.9)	
Non-employed	0 (0)	2 (100)		2 (100)	0 (0)		0 (0)	2 (100)	
Years of experience									
1-5 years	34 (44.7)	42 (55.3)		76 (100)	0 (0)		15 (19.7)	61 (80.3)	
5-<10 years	13 (26.5)	36 (73.5)	0.153 [b]	49 (100)	0 (0)	0.701 [b]	6 (12.2)	43 (87.8)	0.480 [b]
10-<20 years	45 (36)	80 (64)		124 (99.2)	1 (0.8)		27 (21.6)	98 (78.4)	
≥20 years	23 (44.2)	29 (55.8)		52 (100)	0 (0)		8 (15.4)	44 (84.6)	

a: Independent samples t-test. b: Chi-square test. c: Fisher's exact test

TABLE (8) Relationship between the mean scores of knowledge, attitude and practice regarding green dentistry and demographic characteristics.

demographic characteristics	Knowledge		Attitude		Practice	
	mean± SD	*p* value	mean± SD	*p* value	mean± SD	*p* value
Age	r=0.043	0.460 [a]	r=0.150	**0.009** [a]	r= -0.06	0.298 [a]
Gender						
Male	4.33±1.9	**0.038** [b]	17.3±2.3	**0.042** [b]	2.6±1.45	**0.048** [b]
Female	4.98±2.3		17.9±2.9		2.25±1.3	
Qualifications						
BDs	4.9±2.4	0.324 [c]	17.5±2.21 [*]	**0.004** [c]	2.34±1.4	0.525 [c]
MDs	4.56±2.05		17.47±2.1 [#]		2.44±1.3	
PhD	5.0±2.16		18.3±1.8 [*,#]		2.22±1.3	
Place of work						
Governmental sector	4.98±2.37	0.641 [c]	17.77±2.1	0.899 [c]	2.3±1.4	0.826 [c]
Private sector	4.6±2.08		17.7±2.3		2.37±1.2	
Other	5.0±1.2		17.4±3.1		2.33±1.5	
Non-employed	5.0±0.0		17.0±2.2		1.5±0.7	
Years of experience						
1-5 years	5.01±2.3	0.269 [c]	17.3±2.4	0.153 [c]	2.42±1.38	0.429 [c]
5-<10 years	4.45±2.3		17.5±1.9		2.04±1.29	
10-<20 years	4.7±2.2		17.9±2.5		2.39±1.38	
≥20 years	5.25±1.9		17.98±1.7		2.33±1.39	

a: Spearman correlation. b: Independent samples t-test. c: ANOVA test. *,#: Post hoc Bonferroni test; significant difference between groups having same symbols.

DISCUSSION

Providing sustainable and environmentally acceptable dentistry is the new era. We found that there is not enough literature up to our knowledge present about green dentistry in the Egyptian society. Thus, this study addresses and explores the knowledge, attitude, and practice of dentists about green dentistry. This will provide the dentists with better understanding of green dentistry concepts.

More than half of our participants had poor knowledge score. This is in disagreement with (Nagarale et al., 2022) who found fairly good knowledge due to the change in concepts after pandemic area that led to shifting to green dentistry. We think that this score in our study is affected by the wrong answers to certain questions as they are not aware of the contribution of dentists in the total mercury load entering wastewater, the number of sterilization pouches dumped into landfills, dental instruments can be recycled, biodegradable electronic supplies, programs endorsed by (EDA), eco-friendly amalgam management practice, and type of flooring.

Slightly more than half of the participants were aware with eco-friendly dentistry term which is more than those participants in the study performed by (Prathima et al., 2017) and less than those studies performed by (Nagarale et al., 2022; Pallavi et al., 2020).

Good-fair attitude was reported by the majority, and this might be attributed to their agreement that green dentistry is an ethical duty that can increase the work efficiency with minimal resources and no additional costs. Also, they agreed that green dentistry practices need formal education. This is in accordance with (Nagarale et al., 2022).

Participants were more neutral towards the attraction of more patients to the clinics with eco-friendly practices than agreement and disagreement options and this is similar to (Nagarale et al., 2022) who had slightly higher neutral answers and in disagreement with (Parakh *et al*., 2020).

Most of the participants in our study had bad practices as they reported they do not turn off the water while lathering and this is in contrast to (Nagarale et al., 2022) who mentioned that most of the participants turn off the taps while washing their hands during lathering.

Also, in our study we have participants who do not have any energy or paper waste management practices or even use eco-friendly items instead of disposable ones. Also, they do not use proper methods for personal protection equipment. Practices are usually related to the knowledge and as we have poor knowledge scores in our study that might have affected the practices of participants as mentioned by (Verma et al., 2020).

This study showed that most of the participants maintained digital records similar to (Nagarale et al., 2022) but higher than that study performed by (Chopra & Raju, 2017).

Male participants were underrepresented in comparison to females. This is because most males have no time in comparison to females in accessing social platforms. Females are keener to participate than males for academic purposes according to (Mazman & Usluel, 2011).

There were no statistically significant differences regarding knowledge and attitude scores and the studied sociodemographic characteristics. Regarding practices, females had bad practices than males and this might be attributed to the number of participated males as it is much less than females.

A mild positive correlation found between attitude and age. Females had higher knowledge and attitude scores than males, however, males had higher practice scores than females. Dentists with PhD showed higher attitude scores than with BDs and MDs. KAP scores did not show significant differences regarding place of work and years of experience.

From the strength of our study, a validated questionnaire that was self-administered was distributed online. There was no interviewers' bias or selection bias. We explored an important concept that has limited data in our society. While, from the limitations of our study, accessibility of the questionnaire was only for dentists who have social platforms and those without these platforms were not accessible. Also, male participants were underrepresented in comparison to females.

CONCLUSIONS

Participants had poor knowledge, good-fair attitudes, and bad practices regarding green dentistry concepts. Further studies are required with more representation of the males in the sample to explore the differences in gender regarding attitude and practices. It is recommended to teach and implement the concepts of green dentistry at universities in undergraduate and postgraduate studies. Also, spreading the green dentistry concept among graduate dentists through webinars, seminars and workshops are needed.

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