ORIGINAL ARTICLE

Awareness of the Green Dentistry Concept among Dental Professionals in Tertiary Care Dental Hospital, Rawalpindi

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ABSTRACT

Objective: To assess awareness of green dentistry among graduates, postgraduates and general dentists

Study Design: Descriptive Cross-sectional.

Place and Duration of Study: The study was conducted at Armed Forces Institute of Dentistry (AFID) Rawalpindi, Pakistan from August 2022 to October 2022.

Methods: Based on a pre-validated survey questionnaire comprising of 20 close-ended questions assessing the awareness regarding green dentistry. Male and female respondents consisting of General dentists, graduates, postgraduate and house officers, and practitioners of AFID who gave consent were included in the study. The sample size was calculated using the WHO calculator and 332 respondents were recruited and the questionnaire was distributed, responses were then analyzed using SPSS version 22 and the *p*-value < 0.05 was considered significant.

Results: Out of the 332 participants 148 were post-graduates, 109 were Graduates, 35 were consultants and 40 were general dentists with the age range of 25 to 50 years. 248 participants were females and 84 were males and 100% response rate was observed. Postgraduates (47%) were more aware of the eco-friendly dentistry concept the difference was found statistically significant (*p*-value <0.000).

Conclusion: Most of the respondents were aware of the green dentistry concept, those who had little knowledge were accepting the concept and were enthusiastic to inculcate these practices in their practices.

Key Words: *Amalgam, Eco-Friendly Dentistry, Hazards, Questionnaire.*

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Introduction

Global sustainability is one of the major concerns in today's world due to rising pollution and rapidly changing climates.[1] Since 1992, several conferences have been held to build a framework for the advancing world's road to development,[2] and in September 2000, Millennium Development Goals were set, encouraging countries worldwide towards creating a more sustainable environment.[3] 21 years later, 193 countries by November 2021 had their hands joined in this agreement to strengthen climate action.[1] However, to bring about an evolutionary improvement globally, serious environmentally sustainable actions on national and international levels are capitally needed to mitigate the hazardous global emissions.[4]

Dentistry, as a vital healthcare profession, has a significant impact on the environmental wastes produced through its' practices. According to the Eco-Dentistry Association, dental practices discard approximately 680 million dental barriers and dispensers, light handle covers, and towel patient bibs, as well as 1.7 million sterilization pouches each

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year.[5] In light of the recent COVID-19 pandemic, necessary usage of single-use disposables, PPEs, single-dose prescribed materials, protective barriers, disinfection, and sterilization protocols. Nonetheless, emphasis needs to be laid on reviewing practices that are environmentally sustainable and favorable to adapt to the pandemic as well as the posed carbon footprint.[3,5] Other disposables include gloves, surgical masks, suction tips, saliva ejectors, needles, and paper. Much of this waste does not easily decompose. In addition, dental practices generate 4.8 million lead foils, 28 million liters of used X-ray fixers from the processing of radiographic films, and 3.7 tons of mercury-containing wastes and discarded mercury-containing products annually all of them had serious effects on health.[3,4,5] It stated that estimated carbon dioxide emissions through dental practices were 675 kilotons, as it is a very resource and labor-intensive, and energy-consuming field.[6] Amalgam-filling material, which contains primarily 50% mercury and causes changes in pH oxygen availability, and temperature if released into the environment, also donates to the wastes produced. It poses as a serious threat to human health if it enters the drinking and irrigation processes. A cross-sectional study was carried out among dental practitioners in Lahore, Pakistan regarding the use and disposal of amalgam waste. It concluded that there was a significant gap in the familiarity of dentists pertaining to the use and proper disposal of amalgam, where approximately 76% of respondents were uninformed about the disposal of dental amalgam and the guidelines of Minamata Convention.[7,8]

In the 1960s and 1970s, Rachel Carson, a conservationist, began an environmental movement with the publication of his book “The Silent Spring”.[9] It further gave rise to aiming curb on environmental waste with emphasis on 'eco-friendly dentistry', which soon gained its popularity, and the consequent surge has extended till the present day. The EDA (Eco-dentistry Association) defines Green Dentistry as a futuristic approach to abate the environmental impact of dental practices and encompasses ecologically responsible measures that promote pollution prevention, and health and sustain wellness for present and future times.[10]

This research is unique as in our knowledge no such concept was evaluated in Pakistan. This study aims to assess and evaluate the prevalence of awareness of Green Dentistry and consequently the dire need of education to provide enough knowledge.

Methods

This descriptive cross-sectional study was conducted at Armed Forces Institute of Dentistry (AFID) Rawalpindi, Pakistan. The sampling technique was consecutive non non-probability, self-administered type questionnaire based. The ethical approval of the study was obtained from the Institutional Ethical Committee, with the reference number. DIR/KMU AS & RB/IM/00081 dated 10th July 2022. The estimated duration was kept 3 months from August 2022 to October 2022 and the sample size of 323 was calculated using a WHO calculator with a confidence interval 95%, population proportion 50% and population size 2000. A 20-item based close questionnaire was selected from previous surveys done on same topic keeping in mind our resources and environment. The questionnaire was then distributed among 350 respondents over and above the estimated sample size as there are chances of exclusion of respondents who do not meet criteria such as missing responses, who were unable to understand the main concept of the study and do not return the questionnaire back. The inclusion criteria was male and female respondents consisting of General dentists, graduates, postgraduate and house officers, and practitioners of AFID who gave consent. The collected data was then analyzed and tabulated using SPSS software version 22. The significance level was fixed at 5% (alpha=0.05). Statistical analysis was done using descriptive statistics and the Chi-square test was used to understand proportions.

Results

Respondent's demographic data is illustrated in (Table-1 and Figure.1), where the total number of participants was 332 out of which 148 were post-graduates, 109 were Graduates, 35 were consultants and 40 were General Dentist of 25 to 50 years. 248(73.60%) participants were females and 84(24.90%) males. 100% response rates were observed.

Table-2 depicts the awareness of eco-friendly

dentistry among study participants. Results showed that 117(47%) of Postgraduates, 81(32.5%) graduates, 16(6.4%) consultants, and 35(14.1%) 0f general dentists were aware of the eco-friendly

Table -1: Demographic data

Frequency Distribution of Academic status and Experience no. 332			
Academic Status	**Frequency/percentages**	**Clinical Experience**	**Frequency/Percentages**
Consultants	35 (10.5%)	>15 Years	13 (3.9%)
Post Graduates	148 (44.5%)	11-15 Years	28 (8.4%)
Graduates	109 (32.8%)	6-10 Years	52 (15.6%)
General Dentists	40 (12%)	0-5 Years	239 (71.9%)

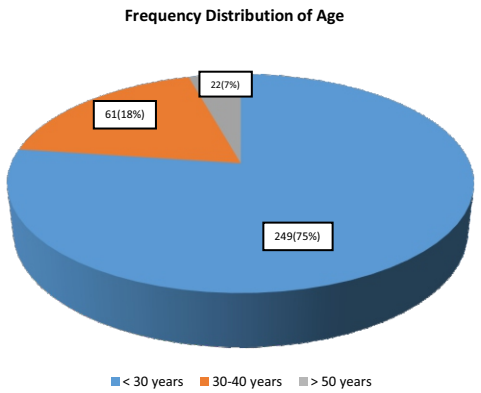

Fig.1: Demographic data of frequency distribution of age

concept and it was reported that the difference was statistically significant with the *p*-value<0.000. Among different groups of Dental Practitioners, Postgraduates have a higher awareness of the harm done by dental amalgam 120(43.3%), radiographic chemicals 80(34.3%), plastic barrier 83(33.5%), disinfectant solutions 71(42.0%) and incorporation of plants within their clinical setups 50(32.5%) with statistically significant results *p*-value<0.000. Postgraduates were more conscious regarding eco-friendly strategies to keep records of material usage and wastage 94(42.9%) and implementing waste segregation protocol 79(36.7%) in comparison to other dental practitioners. Statistically significant results were found with a *p*-value<0.001. In contrast to practitioners, postgraduates knew about using biodegradable housekeeping materials 93(41.2%) and how to use a dry dental vacuum or stainless 64(37.2%). A statistically significant difference was observed with a *p*-value<0.004.

Table-3 portrays the knowledge regarding eco-friendly dentistry among different dental practitioner groups. 137(43.1%) postgraduates used disposable drapes among other dentists' statistically significant group (*p*-value<0.011). Increased enthusiasm has been observed in postgraduates to shift to SS glasses and cloth drapes 52(51.5%). Postgraduates 73(50.7%) have a greater knowledge that shifting to green practice will be economical to dentists and to acquire green practice, minimal resources & no additional cost of basic infrastructure required 62(50.8%) in comparison to graduates, consultants, and general dentists. It was reported that the difference was statistically significant with the *p*-value<0.000. 116(48.3%) postgraduates argued that energy management is beneficial in green dentistry (*p*-value<0.001).

Discussion

Eco-Dentistry or Green Dentistry,[10] has taken dentistry beyond the point of preventing pollution to a place of promoting sustainability. The response and interest of participant were remarkable, despite several voids in knowledge regarding green practice most of them were enthusiastic to shift their practice towards eco-friendly dentistry. In our study 47% of students were found to be more aware of eco-friendly practices as compared to consultants 14.1% a statistically significant difference was observed, the reason may be that postgraduate students have more updated knowledge and are continuously involved in professional development.

The postgraduates also seem aware of harm produced by amalgam and disinfectant solutions. Postgraduates were more conscious of eco-friendly strategies and willing to incorporate them in their daily practice, but the main barrier is the economic constraints.[11] Dental practitioners and postgraduates

Table-2: Awareness of Eco-Friendly Dentistry among Different Dental Practitioner's Group

Question	Academic Status				*P*-Value
	Graduates	Post - Graduates	Consultants	General Dentist	
Awareness of Eco - Friendly Concept	81 (32.5%)	117 (47.0%)	16 (6.4%)	35 (14.1%)	0.000
Follow few strategies	67 (31.5%)	97 (45.5%)	14 (6.6%)	35 (16.4%)	0.000
Aware of Harm Done to Environment by Dental Practice	94 (32.8%)	120 (41.8%)	33 (11.5%)	40 (13.9%)	0.029
Felt Responsible not to Harm Environment	103 (35.5%)	122 (42.1%)	34 (11.7%)	31(10.7%)	0.000
Tried to Reduce Harm Done to Environment	94 (37.2%)	104 (41.1%)	30 (11.9%)	25 (9.9%)	0.002
Aware of Harm Done by Dental Amalgam	105 (36.3%)	120 (43.3%)	26 (9.4%)	37(13.4%)	0.000
Aware of Harm Done by Radiographic Chemicals	86 (36.9%)	80 (34.3%)	31 (13.3%)	36(15.5%)	0.000
Aware of Harm Done by Plastic Barrier	99 (39.9%)	83 (33.5%)	31 (13.3%)	36(15.5%)	0.000
Aware of Harm Done by Disinfectant Solutions	69 (40.8%)	71 (42.0%)	25 (14.8%)	4(2.4%)	0.000
Aware of Harm Done by Sound Pollution	79 (37.8%)	81 (38.8%)	27 (12.9%)	4(2.4%)	0.000
Aware of Harm Done by Unorganized Waste Disposal	96 (37.5%)	94 (36.7%)	34 (13.35%)	32(12.5%)	0.000
EFS Reported by Dentists: Keeping Records of Material Usage and Wastage	83 (37.9%)	94 (42.9%)	14 (6.4%)	28(12.8%)	0.001
EFS Reported by Dentists: Following Proper Waste Disposal Protocol	104 (35.7%)	113 (38.8%)	34 (11.7%)	40(13.7%)	0.000
EFS Reported by Dentists: Implementing Waste Segregation Protocol	83 (38.6%)	79 (36.7%)	27 (12.6%)	26(12.1%)	0.001

EFS Reported by Dentists: Provision of Recycle of Material	60(31.7%)	80(42.3%)	18(9.5%)	31(16.4%)	0.046
EFS Reported by Dentists: Encourage Recycle Concept	79(38.0%)	83(39.9%)	16(7.7%)	30(14.4%)	0.003
EFS Reported by Dentists: Incorporation of Plants	58(37.7%)	50(32.5%)	20(13.0%)	26(16.9%)	0.000
EFS Reported by Dentists: Using Biodegradable House Keeping Materials	86(38.6%)	93(41.7%)	24(10.8%)	20(50.0%)	0.004
EFS Reported by Dentists: Using Dry Dental Vacuum or Stainless	59(34.35%)	64(37.2%)	21(12.2%)	28(16.3%)	0.013

Table-3: Knowledge Regarding Eco-Friendly Dentistry Among Different Dental Practitioner's Group

Academic Status	Chi-Square Value	*P*-value	Yes	No
Do You Use Disposable Drapes				
Graduates			109(34.3%)	0
Post-Graduates	9.001 [a]	.001	137(43.1%)	11(78.6%)
Consultants			35(11.0%)	0
General Dentist			37(11.6%)	3(21.4%)
Do You Think Digital Radiography Greener than Conventional Radiography				
Graduates			101(36.1%)	4(22.2%)
Post-Graduates	11.153 [a]	.006	114(40.7%)	9(50.0%)
Consultants			33(11.8%)	2(11.1%)
General Dentist			32(11.4%)	3(16.7%)
Do You Think We Should Shift to SS Glasses & Cloth Drapes				
Graduates			23(22.8%)	51(35.7%)
Post-Graduates	30.821 [a]	.000	52(51.5%)	70(49.0%)
Consultants			8(7.9%)	7(4.9%)
General Dentist			18 (17.8%)	15(10.5%)
Green Practice Require Minimal Resources & no Additional Cost of Basic Infrastructure				
			Agree	**Disagree**	**Maybe**
Graduates			30(24.6%)	21(24.1%)	58(47.9%)
Post-Graduates	36.486[a]	.000	62(50.8%)	44(50.6%)	40(33.1%)
Consultants			19(15.6%)	11(12.6%)	5(4.1%)
General Dentist			11(9.0%)	11(12.6%)	18(14.9%)

Shifting to Green Practice will be Economical to Dentist					
Graduates			41(28.5%)	10(17.2%)	58(44.6%)
Post-Graduates	45.491[a]	.000	73(50.7%)	34(58.6%)	41(31.5%)
Consultants			12(8.3%)	11(19.0%)	12(9.2%)
General Dentist			18(12.5%)	3(5.2%)	19(14.6%)
Do You Think Green Dentistry Plays a Role in Environment Conservation					
Graduates			93(32.6%)	4(23.5%)	12(40.0%)
Post-Graduates	9.769[a]	.031	120(42.1%)	13(76.5%)	15(50.0%)
Consultants			32(11.2%)	0	3(10.0%)
General Dentist			40(14.0%)	0	0
Is Energy Management Beneficial in Green Dentistry					
Graduates			63(26.3%)	3(27.3%)	43(53.1%)
Post-Graduates	17.799[a]		116(48.3%)	7(63.6%)	25(30.9%)
Consultants		.001	27(11.3%)	1(9.1%)	7(8.6%)
General Dentist			34(14.2%)	0	6(7.4%)
Will Increase GP Awareness Led to Patients Selecting Dentists Practicing Green Dentistry					
Graduates			48(26.8%)	12(28.6%)	49(44.1%)
Post-Graduates	19.493[a]	**.**000	87(48.6%)	19(45.2%)	42(37.8%)
Consultants			30(16.8%)	1(2.4%)	4(3.6%)
General Dentist			14(7.8%)	10(23.8%)	16(14 4%)
Before Switching to GP, I Will Undergo its Effectiveness Trial					
Graduates			91(34.7%)	3(12.0%)	15(33.3%)
Post-Graduates	16.388[a]	.003	105(40.1%)	17(68.0%)	26(57.8%)
Consultants			31(11.8%)	0	4(8.9%)
General Dentist			35(13.4%)	5(20.0%)	

both were aware of using biodegradable materials but most of them used them 50.7% in their daily practice and agreed to shift towards eco-friendly products. Most of our respondents were below 30 years of age (74.8%) with experience of 6 to 10 years and were females (73.6%) this shows an increasing number of females who graduated in dentistry. Dental graduates were found more aware of hazards produced by radiographic chemicals (36.9%) and plastic barriers (39.9%). Graduates were more aware of unorganized waste as compared to postgraduates who were more encouraged to incorporate plants in their setups,[12] same results were observed in a study by Adam E.[13] Implementation of new strategies to reduce the waste generated by the dental profession feasibly and sustainably and is the main rationale behind green dentistry[11] by adopting and advocating the four 'R'.[12] It is commonplace to perceive recycling as the first step but the reduction in waste production and rethinking and reusing our things are much more effective similar results were seen in our study where all of the respondents agreed to the provision of recycling materials. The key to reducing our waste is to extend the life of things we use. Moreover, by implementing these four easy steps, dentistry, and dental hygienists can transform the dental health profession into a greener and cleaner one.[14]

There are innumerable ways to introduce eco-friendly dental practices, such such digital X-rays, low energy bulbs and motion sensors can be introduced, reducing water wastage, using amalgam separators

on chairs and sinks can reduce amalgam pollution, reducing paper usage, and recycle wherever possible and investing in energy-efficient equipment can significantly help.[15]

Siddhi Passi et al. reported in their review article that the major cause of pollution in dentistry is the usage of disposable items.[16] In fact, in this study 65.6% and 68.4% of dental surgeons use disposable cups and drapes, similar results seen in our study 34.3% and 43.1% students and residents use disposable item in their daily practice. There is a lot of disposable waste that is generated in a non-green practice.83.4% of dentists believed that digital radiographs are much better than the conventional ones as compared to a similar study,[17] where only 79.9 % believed the same.

In our study 73% of postgraduates believe that green dentistry will not burden their practices, a difference in opinion was seen in a study done in Thailand[9], 54.4% of individuals thought that shifting to a green practice would increase their financial burden whereas in study by Parkash et al. 63.2% people believed green practice will be more economical these results are closer to this study.[18] But when the respondent was asked in the current study whether to shift to more environment-suitable supplies, most of them agreed.

The present study reported that 50% of dentists believed that the future patients will be aware and picky of incurring treatment mostly from Green Practices whereas the study done by Bhargav et al. presented that 74% agreed.[17]

There is a higher proportion of dentists willing to adopt green practices on a small scale first and the establish it in their practice (*p*-value=0.003) which shows a high acceptance rate of such practices. When asked if such a practice would require minimum cost and infrastructure, most of respondents were agreed (*p*-value=0.000), there is awareness regarding the need for green practice, the uncertainty and inexperience[19] of such practice is the major limitations in today's dental practice. Dentists throughout the country should work together to decrease the environmental impact of dental practice.

Conclusion

Most of the respondents especially consultants were aware of the green dentistry concept, others with minimal knowledge accepted the concept and were enthusiastic to inculcate these practices in their practices. Effective tanning is required to popularize the concept and it is recommended to include the eco-friendly concept in the curriculum as well.

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Authors Contribution

VB: Idea conception, study designing, data collection, data analysis, results and interpretation
EA: Study designing, data analysis, results and interpretation, manuscript writing, and proofreading
SM: Data analysis, results and interpretation, manuscript writing, and proofreading
SAH: Idea conception, study designing, data collection, data analysis, results and interpretation
AB: Idea conception, data collection, manuscript writing, and proofreading
RU: Idea conception, data collection, manuscript writing, and proofreading