Research article

Eco-friendly dentistry: Awareness and its implementation among private dental practitioners of Mangalore taluk of Karnataka, South India – A cross sectional study

Nafiya Abdul Aziz[1], Anupama Rao[2], Vijaya Kumar[2], Neevan D'Souza[3]

[1]Department of Prosthodontics, [2]Department of Periodontology, Yenepoya Dental College, Yenepoya (Deemed to be University), Deralakatte, Mangalore, 575018, Karnataka, India

[3]Department of Biostatistics, Nitte Deemed to be University, Deralakatte, Mangalore, 575018, Karnataka, India

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Corresponding author: **Anupama Rao.** Email: dranupamarao@yenepoya.edu.in

ABSTRACT

Introduction and Aim: Promotion of optimal usage of non-toxic materials, alternative energy sources, reusable products, minimising paper waste and negligible carbon footprints has brought eco-friendly dentistry in limelight. The aim of the study was to evaluate the awareness and practice regarding eco-friendly dentistry among private dental practitioners of Mangalore Taluk, South India.

Materials and Methods: A total of 104 Dental practitioners with a qualification of BDS/MDS, practicing dentistry were randomly participated in a study after obtaining institutional ethical clearance. A total of 30 item closed-ended self-designed validated questionnaires were provided among participants. Assessment of knowledge and practice of the participants were carried out under four sections 1) Radiographic waste management, 2) Biomedical waste management, 3) Amalgam management, and 4) Eco-friendly dental practice. Knowledge, attitude and practice of eco-friendly dentistry among all the dental practitioners were assessed using descriptive statistics and Fisher's exact/chi -square test.

Results: Present study did not find any statistically significant difference in attitude, knowledge and practice among BDS and MDS dental practitioners, among male and female practitioners and among practitioners with and without 10 years of experience. 57% participants agreed to the fact that lack of awareness is a major barrier to implement eco- friendly dentistry at practice.

Conclusion: Conducting CDE programs, workshops, and seminars can bring change and foster a favourable attitude among dentists about transitioning from conventional to green dentistry. Governmental policies can be framed towards eco-friendly dental practice in order to implement green dental practice compulsorily by all the dental practitioners.

Keywords: Dentistry; private practice; environment; survey; awareness; implementation.

INTRODUCTION

Environmental pollution is the one of the biggest problems that the world has recently faced (1). It majorly contributes to climate change which is the world's most existential crisis (2). Dental professionals being a part of healthcare providers share a global responsibility in reduction of biomedical waste which potentially has a deleterious impact on human and environmental wellbeing (3).

Dental offices all over the world produce garbage that eventually ends up in landfills and water supplies, including amalgam restorative materials, plastic coverings, radiography chemicals, lead foils, and disinfection solutions (4). Globally, the mercury load released from amalgam restorative material used in dental practice ranges between 6% to 35% of the total, entering directly into the environment (5). Over the years there has been a shift towards eco-friendly dental practice in many parts of the world. Promotion of optimal usage of non-toxic materials, alternative energy sources, reusable products, minimising paper waste and negligible carbon footprints has brought eco-friendly dentistry in limelight (6). Implementation of environment friendly dental practice can substantially minimise waste generation and thereby reduce air and water pollution (7). Even though there has been a plethora of literature available on various dental practice strategies which can be easily adopted by dental professionals regarding eco-friendly measures, most of the dental practitioners are unaware of it (2,8,9). There are no specific guidelines available on implementation of eco-friendly dental practice in India (10). It's a need of the hour to implement eco-friendly measures in private dental practice to reduce potential environmental damage. There are only a few studies which address the level and extent of awareness among private dental practitioners regarding eco-friendly dental practice in India (10-12). Therefore, the aim of the study was to assess the awareness and practice regarding eco-friendly dentistry among private dental practitioners of Mangalore taluk, South India.

MATERIALS AND METHODS

A total of 104 dental practitioners with a qualification of BDS/ MDS practicing at their private dental clinic of Mangalore Taluk, South India, participated in the

study by simple random sampling technique after obtaining institutional ethical clearance. The list of dental practitioners working in various private clinics of Mangalore Taluk was procured from the Indian Dental Association, DK branch office. A self-designed, electronic survey (Google survey) consisting of 30 closed ended questionnaire items (MCQ's, yes/no) were formulated and content and construct validity were checked by two subject experts. The pilot testing of the questionnaire was carried out with 10 volunteer private dentists to offer suggestions on content, clarity, and format of the proposed questionnaire. The questionnaire sent to the participants through E-mail or WhatsApp had questions mainly on four sections 1) Radiographic waste management, 2) Biomedical waste management, 3) Amalgam management, and 4) Eco-friendly dental practice. The dental practitioners were instructed to select only one answer which they feel was the most accurate. The study protocol followed the STROBE criteria.

Informed consent was obtained from the dental practitioners after describing the objective of the study and the assurance to maintain anonymity and confidentiality. Dental practitioners not having their own clinical set up or only working in dental colleges were excluded from the study. Sample size was calculated using the formula:

$$n=\left(\frac{Z_{1-\alpha/2}\ \sigma}{d}\right)^2$$

at 5% level of significance and standard deviation 13.10 (11) with precision of 3%. The total sample size estimated for the present study was 73. Statistical analysis was done using IBM Statistical Program for Social Sciences IBM® SPSS® Statistics V22.0 (SPSS Inc., Chicago Illinois, USA). Descriptive statistics was expressed as mean, SD, frequency and percentage regarding knowledge, attitude, and practice of eco-friendly dentistry among the study participants. Independent t test was used to test for significance difference in knowledge score between gender, qualification and years of experience. Fisher's exact test/Chi –square test was used to find the significance between categorical variables for attitude and practice. P<0.05 was considered statistically significant.

RESULTS

Knowledge

About 86 (82.7%) private dental practitioners knew that digital dental radiography technique is eco-friendlier than the conventional radiography. Only 10 (9.6%) participating dentists were aware that in conventional radiography, fixer processing solutions were hazardous after its use. Nearly 59 (56.7 %) were not sure of the environmentally friendly cleaners suitable for the x-ray developer. However, 29 (27.9%) participants felt that non-chromium-based cleaners are less harmful to the environment. Almost 41 (39.4%) practitioners were unaware of the storage of biomedical waste. 58 (55.8%) participants were well informed about the sequence of biomedical waste management. About 40-50% dentists used colour coding bags for the disposal of glassware and metallic body implants, infectious biodegradable and infectious non-biodegradable biomedical waste. Majority of participants, 55 (52.9%) were not sure about the management of mercury spill in the clinic. About 43 (41.3%) participants stored excess silver amalgam in an airtight container under water containing a photographic fixer.

There was no statistically significant (P=0.075) difference noted in knowledge scores among males (4.11 ±1.96) and females (4.79 ± 1.91); in knowledge scores among <=10yrs (4.61 ± 1.82) and >10yrs (4.23 ± 2.19) of dental practice (P=0.350); in knowledge scores among BDS (4.52±1.81) and MDS (4.47± 2.01) practitioners (P=0.908).

Attitude

All of the participating dentists, 104 (100.0%) felt the need for setting up a governing body to issue rules for the proper treatment of dental radiographic waste and also acknowledged alternate restorative material to dental amalgam such as composite, ceramic, porcelain can reduce environmental impact. All 104 (100.0%) participants were aware of the amalgam hazards to the environment. Almost 84 (80.0%) knew about the enactment of guidelines for biomedical waste disposal by the Government of India. 64 (61.5%) dentists were well informed about the concept of green dentistry. About 42 (40.4%) were aware but had not yet implemented green dentistry in their practices.

There was no statistical significance difference seen in attitude scores among males and females; <=10yrs and >10yrs of dental practice and among BDS and MDS practitioners.

Practice

Almost 43 (41.3%) used digital dental radiographs in their private clinics. 36 (34.6%) Dentists stored x-ray film using foil and x-ray films separately and then disposed of in secured landfills by experts. Whereas 30 (28.8%) were not sure as their dental assistants were performing the task of disposal. While using digital radiography, 51 (49.0%) dentists did not give prints for each and every patient. Majority of 62 (59.6%) used a colour coding system for disposing of waste. 45 (43.3%) dentists used yellow bags to dispose of used impression materials, soiled dental casts, discarded medicine and expired dental materials. However, 20 participants (19.2%) were aware about the use of black bags for disposal. 48 (46.2%) dentists used puncture proof bags to dispose of infected needles. The alternative restorative material was used more regularly than dental amalgam

by 68 (65.4%) dentists. The practice of using reusable materials, LED light bulbs, minimizing paper and plastic waste was done by 80 (76.9%) participants. Most of the dentists, 49 (47.1%) dealt with the plastic waste generated in the clinic by using sterilisable items, minimizing the use and also disposing it as non-biodegradable biomedical waste.

There was a significant statistical difference noted regarding usage of pre capsule alloy with amalgamator among gender (P=0.005), qualification (P=0.008) and years of dental practices (P=0.046) as shown in Table1. There was a significant statistical difference seen regarding use of reusable materials among gender (P=0.023) and qualification (P=0.045) as shown in Table 2. There was a significant statistical difference noted between gender and placement of rubber dam during removal of amalgam restorations (P=0.001) as shown in Table3. There was significant statistical difference seen among gender and dealing with plastic waste generated in the clinic (P=0.023) as shown in Table 4.

DISCUSSION

Understanding the concept of eco-friendly dentistry is very important in this era of climate change. Eco-friendly dentistry aims to lessen the negative effects of dental procedures on the environment and raise patient understanding of the environment and sustainability (13). In this context, the present study was aimed to assess awareness and practice of private dental practitioners of Mangalore taluk of Karnataka, India regarding eco-friendly dentistry.

Table 1: Association between sex, education and experience with usage of amalgamator

Variables		**Amalgamat or**			***p***
		Always	**Sometimes**	**Never**	
Sex	Male (n=32)	12 (37.5%)	3 (9.4%)	17 (53.1%)	0.005
	Female (n=38)	12 (31.6%)	16 (42.1%)	10 (26.3%)	
Education	BDS (n=19)	9 (47.4%)	8 (42.1%)	2 (10.5%)	0.008
	MDS (n=51)	15 (29.4%)	11 (21.6%)	25 (49.0%)	
Experience	<=10 yrs (n=52)	16(30.8%)	18(34.6%)	18(34.6%)	0.046
	>10 yrs (n=18)	8(44.4%)	1(5.6%)	9 (50.0%)	

n= number of subjects; *P*-value below 0.05 indicates a significant outcome

Table 2: Association between sex, education regarding usage of reusable materials

Variables		**Reusable**		***p***
		Yes	**No**	
Sex	Male (n=47)	41(87.2%)	6 (12.8%)	0.023
	Female (n=57)	39(68.4%)	18 (31.6%	
Education	BDS (n=27)	17 (63.0%)	10 (37.0%)	0.045
	MDS (n=77)	63 (81.8%)	14 (18.2%)	

n= number of subjects; *P*-value below 0.05 indicates a significant outcome

Table 3: Association between sex and placement of rubber dam during removal of amalgam

Variables		**Dam**		***p***
		Yes	**No**	
Sex	Male(n=32)	4 (12.5%)	28 (87.5%)	0.001
	Female (n=40)	21 (52.5%)	19 (47.5%)	

n=number of subjects; *p*-value below 0.05 indicates a significant outcome

Table 4: Association between sex and dealing with plastic waste

Variables		**Plastic**				***P value***
		Try to use reusable items much as possible as I can	**Minimize the use**	**Dispose as non-biodegradable biomedical waste**	**All of the above**	
Sex	Male (n=47)	3 (6.4%)	11 23.4%)	5 (10.6%)	28 59.6%)	0.027
	Female (n=57)	15 (26.3%)	15 (26.3%)	6 (10.5%)	21 36.8%)	

n= number of subjects *p*-value below 0.05 indicates a significant outcome

In the present study, 45.2% males and 54.8% females had participated whereas in the study by Qarni *et al.*, there was a higher proportion of male (78.5%) and a smaller number of female dentists (21.25%; 8). Our study reveals that the concept of green dentistry was known to 61.5 % participating dentists which is like a study conducted in Jordan by Shatrat *et al.*, where more than 50% were aware of the

eco-friendly dentistry concept (3). On the contrary, in a study conducted by Prathima *et al.*, among 800 dental practitioners practising in different parts of India found that only 13.1% of the study population was aware of the term Eco-Friendly Dentistry (11). Our study results highlighted that 41.3% participated dentists used digital radiography in their routine dental practice which is in accordance with the study by Sen *et al.,* in Udaipur, Rajasthan, India where 40.3% used digital radiography (15). In the present study, 26% of the participating dentist's population exclusively used only white coloured restorative materials in their practice and 65.4% practitioners' preferred alternative restorative material rather than dental amalgam for restoration of all kinds of cavities in their private practice. The possible reason for study participants to utilize white restorative material instead of dental amalgam may be due to its requirement of extensive tooth preparation and aesthetic concerns of the patients. In a study conducted in Chandigarh Tri-city, India by Chopra and Raju (10), 98% of dental practitioners adopted alternative materials rather than dental amalgam restoration practices. On the contrary, the study by Sawair *et al.,* reported that about 76% of Jordanian general dentists utilized amalgam as restorative material in their practice (16). The study also showed that Jordan produced the general dentists with the highest Total Amalgam Contact index. This might be due to two factors. Firstly, since amalgam costs less than a comparable composite filling, people might do so for financial reasons. The second factor may be related to the undergraduate dental training program in Jordan, where amalgam is the material of choice for treating moderate to large cavities in posterior teeth.

The dental professionals in the current study, in contrast to those in Saudi Arabia, Nigeria, and South India, were more aware of the environmental dangers posed by amalgam. In spite of the fact that 75% of dentists in Saudi Arabia were aware of the ongoing debate over the safety of amalgam, the study indicated that 85% of them still held this belief (17). According to a study conducted in Nigeria by Udoye and Aguwa (18), more specialists than general dentists (74.5%) agreed that dental amalgam was safe, whereas more general dentists (14.9%) than specialists (4.3%) thought it was dangerous. According to a study by Ramesh *et al.,* (19) at dental clinics in South India, 32% of dentists believe that amalgam poses no substantial health risks over the long or short term for both the dentist and the patient, while the remaining 27.33% are unclear. However, 40.67% of respondents believed that dental amalgam was dangerous for both patients and practitioners. Due to the great strength and durability, it offers, as well as the fact that it is less expensive and accessible to a wider segment of the population, dental amalgam is still used in dental practice (19). It was found that 76.9% dental practitioners in the present study used LED bulbs, minimizing the usage of paper and plastic waste in their dental clinic.

About 59.6% of the participating dentists in the present study followed a colour coding system while disposing of waste generated during their daily practices. According to a survey done among the 64 dentists that make up a government institution's teaching staff in New Delhi, India, most of the respondents were unaware of effective clinical waste management (20). Study conducted among private dental practitioners in Bangalore, South India found that the majority of the practitioners did not abide by the waste management protocol (21). It suggests that the population of dentists in Mangalore taluk are well aware of a colour coding system of waste disposal compared to other parts of the country. It may be due to strict guidelines put forth by authorities for waste disposal in Mangalore taluk. Mangalore City Corporation takes action against the law breakers by implementing fines for those who fail to segregate waste at source. The fine is levied in accordance with the MCC Solid Waste (Management and Handling) Bylaws 2019.

It is the obligation of dental professionals to take an active role in the community and implement "green initiatives" to lessen their environmental impact (22,23). There are several approaches to implement eco-friendly dentistry: 1) Use digital X-rays to cut down radiation exposure and chemicals usage; 2) Low energy bulbs and motion sensors can minimize the electricity consumption; 3) Reduce water wastage and paper usage; 4) Installation of amalgam separators on chairs and sinks to control amalgam pollution; 5) Recycle wherever possible (24,25).

Green dentistry can be brought to effect by precise designing of dental set-up and utilization of eco-friendly products in dental practice. Therefore, upskilling the blooming dentists in their respective field should be the first step towards environmentally friendly dentistry. There is a lacuna of this discipline in the dental education system. This notion should be introduced in the curriculum. Dentists can convert their practices from traditional dentistry to green dentistry with the help of proper education from CDE programs, workshops, and seminars. Government policies can be framed towards eco-friendly dental practice in order to implement green dental practice compulsorily by all the dental practitioners.

The strength of the present study was that all the aspects of eco-friendly dentistry were taken into consideration and a validated questionnaire was formed whose reliability was checked through a pilot study. In our study, only private dental practitioners were chosen because, in contrast to government- or public-sector dentists, they have direct control over their dental offices and treatments.

Limitations

Apart from small sample size, the study's significant limitations include the fact that awareness and practice may differ in urban and rural areas in different regions of the nation.

CONCLUSION

The results of the present study have definitely helped us to understand lacunae in the knowledge and practice of dental practitioners regarding eco-friendly dental practice of Mangalore taluk, south India. Dental health professionals might lead the fight against the climate change movement by promoting and enforcing the four 'R's— Rethink, Reduce, Reuse, Recycle. The prime principle of green dentistry is to develop new schemes to limit the waste produced by the dental professionals. There are many feasible and sustainable methods which can protect the environment from numerous hazards generated in the office. Creating awareness in early life of professional training of dentistry will ultimately help in sustainable climate solutions.

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CONFLICT OF INTEREST

The authors declare no conflicts of interest.

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