Original Article

Green Dentistry: Assessing Carbon Footprint Awareness and Practices Among Dental Professionals

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ABSTRACT

Background: The growing environmental concerns have driven the need for sustainable practices in various sectors, including dentistry. Green dentistry focuses on reducing the carbon footprint of dental practices by minimizing waste, energy consumption, and adopting eco-friendly materials. This study aims to assess the awareness and practices of dental professionals in Chennai, Tamil Nadu, regarding carbon footprints in their practices.

Methods: A descriptive cross-sectional study was conducted from August to November 2024, with 214 randomly selected dentists. Data were collected using a structured questionnaire administered via Google Forms. Data analysis was performed using IBM SPSS Statistics.

Results: A majority (95.3%) of participants were aware of carbon footprints, and 71.5% had received formal training on environmental sustainability. Despite awareness, barriers like cost, material availability, and knowledge gaps hindered full implementation. Most participants (97.6%) were willing to adopt green practices.

Conclusion: While awareness is high, addressing barriers such as cost and accessibility is crucial for widespread adoption of green dentistry.

Keywords: Environmental impact, climate change, sustainability, recycle, eco-friendly practices.

INTRODUCTION

The growing concern over climate change and environmental sustainability has led to a global shift towards eco-friendly practices in various sectors, including healthcare. Among these, green dentistry has emerged as an important concept, focusing on minimizing the environmental impact of dental practices while maintaining high standards of patient care.[1] Dental practices, like many other healthcare services, contribute significantly to the carbon footprint through energy consumption, waste generation, and the use of non-sustainable materials. Despite the awareness of climate change, the adoption of sustainable practices in dentistry remains inconsistent, with many professionals unaware of the environmental footprint their practices generate.[2] Carbon footprint in dental practices refers to the total amount of greenhouse gases emitted, directly or indirectly, through dental activities, including the consumption of energy, water, dental materials, and waste disposal. [3]The implementation of eco-friendly practices—such as reducing waste, using energy-efficient equipment, adopting digital radiography, and sourcing sustainable materials—can significantly reduce this footprint and contribute to a healthier planet.[4] Green dentistry is a modern approach that focuses on minimizing the environmental impact of dental practices. It aims to promote overall well-being by combining dentistry with environmental conservation. This innovative approach is crucial due to the increasing challenges of climate change and the growing concern for environmental sustainability.[5] The dental sector is a significant contributor to environmental pollution, particularly due to the generation of non-biodegradable plastic waste. Improper disposal of dental waste, such as syringes, gloves, and masks, can lead to soil and groundwater pollution, harming both terrestrial and aquatic ecosystems. Inadequate waste management systems and weak regulations further worsen these environmental issues.[6] This study aims to assess the awareness and practices of dental professionals in Chennai, Tamil Nadu, regarding the carbon footprint of their dental practices.

MATERIALS AND METHODS

This study employed a descriptive design to evaluate the awareness and practices related to carbon footprint among dental professionals. The research was conducted over three months, from August to November 2024, which encompassed the phases of data collection, statistical analysis, and report preparation. The study focused on dentists practicing in Chennai, Tamil Nadu, India. The research was carried out through a private dental college in Chennai, utilizing online platforms for data collection. Ethical approval for the study was obtained from the Department of Public Health Dentistry, with clearance granted by the Institutional Review Board. A total of 214 dentists were randomly selected to participate in the study. Demographic information, including age, gender, qualifications, and years of practice, was recorded for each participant.

Table 1: Distribution of knowledge among dental professionals on carbon footprint

Questions	Options	n	%
1.Are you willing to take part in this survey?	Yes	214	100
2.Gender	Male	135	63.1
	Female	79	36.9
3.Education	BDS	88	41.4
	MDS	126	58.9
4.Years of practice	Less than 1 year	15	7
	1-5 years	145	67.8
	6 – 10 years	41	19.2
	10 years and above	13	6.1
5.Type of practice	Private practice	178	83.2
	Private practice and academics	30	14
	Other	6	2.8
6.Are you aware of the term Carbon footprint?	Yes	204	95.3
	No	10	4.7
7.How would you rate your knowledge about the carbon footprint of dental practices?	Excellent	44	20.6
	Good	131	61.2
	Fair	38	17.8
	Poor	1	0.5
	None	0	0
8.Have you received any formal training or education on environmental sustainability in dentistry?	Yes	153	71.5
	No	61	28.5
9.Are you aware of any specific environmental guidelines or regulations for dental practice aimed at reducing carbon emissions?	Yes	178	83.2
	No	36	16.8
10.Have you attended any training or seminars on reducing the environmental impact of dental practices?	Yes	156	72.9
	No	58	27.1
11.Does your clinic track its carbon footprint or overall impact?	Yes	145	67.8
	No	37	17.3
	Planning to start	32	15
12.How often does your clinic conduct maintenance on equipment to ensure energy efficiency?	Regularly (every 6 months)	149	69.9
	Occasionally (once a year)	61	28.5
	Rarely	2	0.9
	Never	2	0.9
13.Does your clinic promote the use of digital solutions (e.g., digital radiography, paperless records) to reduce waste and energy consumption?	Yes	212	99.1
	No	2	0.9
14.Has your clinic considered or implemented water saving devices to reduce water consumption during procedures?	Yes	176	82.2
	No	38	17.8
15.How important do you think it is for dental clinics to reduce their carbon footprint?	Very important	94	43.9
	Important	105	49.1
	Moderately important	11	5.1
	Slightly important	4	1.9
	Not important	0	0
16.What are the main barriers to implementing sustainable practices in your clinic?	Cost of eco-friendly alternatives	51	23.8
	Limited availability of eco-friendly materials	74	34.6
	Lack of knowledge	73	34.1
	Lack of time	16	7.5
17.What additional resources or support do you think would help your clinic to reduce its environmental impact?	Financial incentives	28	13.1
	Training and education on eco-friendly practices	101	47.2
	Access to affordable eco-friendly materials	60	28
	Government regulations and guidelines	25	11.7

A structured questionnaire consisting of 12 questions, both open-ended and close-ended, was administered via Google Forms. Informed consent was obtained from participants to ensure confidentiality and privacy, and they were provided with an explanation of the questions to promote accurate and thoughtful responses. Data was gathered using Google Forms, and participants received clear instructions to ensure they understood the questions. Informed consent was obtained from all participants, and confidentiality was maintained. The collected data was organized in an Excel spreadsheet and analysed using IBM SPSS Statistics for Windows, Version 26.0.

RESULTS

A total of 214 dentists participated in the study, with 63.1% identifying as male and 36.9% as female. Among the respondents, 41.4% had a BDS degree, while 58.9% had an MDS. The majority of participants (67.8%) had between 1-5 years of practice experience, followed by 19.2% with 6-10 years, and 6.1% with over 10 years. Most participants (83.2%) worked in private practice, and 14% were involved in both private practice and academia. When it comes to awareness of carbon footprints, 95.3% of respondents were familiar with the concept, and 61.2% rated their knowledge as good, while 20.6% rated it excellent. A substantial portion (71.5%) had received formal training on environmental sustainability in dentistry, and 83.2% were aware of specific guidelines aimed at reducing carbon emissions in dental practices. Furthermore, 72.9% had participated in seminars or training on reducing the environmental impact of dentistry. Regarding clinic practices, 67.8% of respondents tracked their carbon footprint, and 69.9% ensured regular maintenance of equipment for energy efficiency. Almost all (99.1%) utilized digital solutions to minimize waste and energy use, and 82.2% had adopted water-saving devices. When asked about the importance of reducing carbon footprints, 43.9% considered it very important, and 49.1% regarded it as important. The main barriers to implementing sustainable practices were the cost of eco-friendly alternatives (23.8%), limited availability of materials (34.6%), lack of knowledge (34.1%), and lack of time (7.5%). Finally, 47.2% of respondents suggested that training and education on eco-friendly practices would be helpful, followed by 28% who emphasized the need for affordable materials, 13.1% who wanted financial incentives, and 11.7% who called for government regulations and guidelines.

DISCUSSION

The findings of our study provide valuable insights into the awareness and practices related to reducing carbon footprints among dental professionals in Chennai, Tamil Nadu. The study sheds light on both the strengths and areas for improvement in the adoption of green dentistry practices. In our study, 95.3% of participants were aware of the concept of carbon footprints, and 61.2% rated their knowledge as good, with 20.6% rating it excellent. This high level of awareness aligns closely with the findings of Ammar Alsharmani et al., where most dentists showed higher awareness of green dentistry practices.[7] However, compared to Thakar S et al., where 51.8% of participants were unaware of the concept, our study reflects a notably higher level of awareness among Chennai-based dental professionals.[8] A key finding from our study was that 64.7% of participants believed that shifting to green dentistry would attract more patients, which is slightly higher than Parakh et al.,[9] where 87% of respondents shared this belief. While the percentage is not as high in our study, it still reflects a positive attitude toward the economic benefits of adopting sustainable practices. The slightly lower belief in patient attraction might suggest differences in geographical context or the sample population's perception of patient behavior toward eco-friendly practices. In our study, 71.5% of participants had received formal training on sustainability, and 99.1% used digital solutions to minimize waste. This aligns with Saxena V et al., where 82.9% of respondents recognized the potential for equipment recycling.[10]

Although our study did not directly address equipment recycling, the adoption of digital solutions and other sustainable practices reflects a similar commitment to sustainability. Our study found that 97.6% of participants were willing to transform their practices to reduce their carbon footprint, which aligns closely with findings from Thakar S et al., where 97.6% of respondents also expressed a willingness to transform their practices.[8] This shows a strong willingness among dental professionals to adopt greener practices when provided with the right knowledge and resources. Thakar S et al. also highlighted that 72.3% of participants believed that a carbon emission reduction law amendment should be established across the healthcare sector, and a regulatory body should be formed for implementation and maintenance.[8] This supports our findings, where 47.2% of participants suggested more training and education, followed by a call for financial incentives and government regulations. While the percentages differ, both studies indicate the need for regulatory frameworks to support the shift toward green dentistry. In Nighat Zia et al.'s study, dental practitioners were found to have good knowledge and positive attitudes toward environmental conservation, but the implementation of eco-friendly practices was inadequate.[11]These findings are consistent with the research done by Martin N et al.[12]

This was echoed in our findings, where 95.3% were aware of carbon footprints, but implementation barriers, such as the cost of eco-friendly alternatives (23.8%) and limited availability of materials (34.6%), were significant obstacles to widespread adoption.[12] The barriers identified in our study (cost, limited material availability, and lack of knowledge) resonate with Bano, Vasiqa,[12] and Amin's findings, where most respondents were aware of the green dentistry concept, but those with limited knowledge were still enthusiastic about adopting eco-friendly practices.[13] This suggests that while knowledge is a key enabler, overcoming practical challenges, such as affordability and accessibility, is essential for wider adoption. Integrating

environmental education into dental curricula and conducting workshops can enhance awareness and encourage the adoption of sustainable practices among dental professionals. Despite the growing recognition of green dentistry, challenges remain in bridging the knowledge gap and implementing sustainable practices effectively across the profession. Addressing these issues is crucial for fostering a more environmentally conscious dental community.[14,15]

CONCLUSION

The results of this study indicate that while dental professionals in Chennai are largely aware of the concept of carbon footprints and are taking steps to adopt sustainable practices, there remain significant barriers to full implementation. The high level of awareness and active participation in eco-friendly practices like digital solutions, water-saving devices, and energy-efficient equipment is commendable. However, challenges such as cost, material availability, and knowledge gaps must be addressed to further integrate sustainability into dental practices. Moving forward, more educational initiatives, affordable alternatives, and policy support are essential to accelerate the adoption of green dentistry and reduce the carbon footprint of dental practices.

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