Original Research

Environmentally friendly behavior in dentistry

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Abstract

Background and aims. Sustainability is the sensitive and responsible way of using the natural resources, its goal being to prevent their depletion and preserving the ecological balance. An essential requirement to achieve this is to practice environmentally conscious behavior. The main objective of the present study was to carry out a survey among dentists about the importance of sustainability, feasibility of an environmentally friendly dental practice and the steps in favor of it.

Methods. An online survey with 6 question groups, including a total of 50 questions, was performed. The survey was available online for dentists on different platforms. In total 98 responses were recorded during September − November 2020.

Results. Out of the responding dentists, 74.49% liked the idea of an environmentally friendly dental practice and 98.97% would take some steps toward environmental awareness in their practice. A statistically significant ($p<0.05$) difference between those who prefer an environmentally conscious practice and those who had not yet thought about it was only in the questions related to environmentally conscious lifestyle in their household, the use of environmentally friendly cleaning products, the creation of a 'green wall' and selective waste collection in their practice.

Conclusions. Most of the respondents were open to the idea of forming an environmentally conscious dental practice and they would act to achieve it. In order to reach this, it is necessary to provide dentists with feasible solutions for better practice. Some of the guidance issues, which would be easy to implement, are listed at the end of the present study. We intend to provide a guidance regarding sustainable dental practice.

Keywords: environmental awareness, dentistry, sustainability

Background and aims

The ecological footprint is an important indicator and measuring unit for our consumption. It is used for a person or even a whole nation, like in several European Union (EU) Member States. The ecological footprint includes crop production, grazing, fishing, forest footprint and carbon footprint [1]. The carbon footprint is a significant part of the ecological footprint. Eurostat (European Statistical Office) defines it as the amount of carbon dioxide produced due to the final use of a product, as cited by the Hungarian Central Statistical Office (KSH) [2]. It can be used to determine the impact of human activity on the environment, to show if resources are managed sparingly and sustainably. The larger the carbon footprint is, the greater impact it has on the climate change [2]. To reduce our carbon footprint, we need to develop environmentally conscious behavior. This problem arises also in case of dental practices and other healthcare facilities, and it is not limited to the actual intervention itself, but it is the sum of the emissions created by each stakeholder in the supply chain [3,4]. It is inevitable to measure and mitigate the environmental footprint of technologies related to health care [5].

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Public Health England (PHE) has recognized the importance of an environmentally conscious lifestyle and the reduction of the carbon footprint to protect and improve public health [6]. According to the World Health Organization (WHO) guidelines, every state has an ethical obligation to protect public health by an environmentally conscious behavior [7]. The World Federation of Dentists (FDI) stated that dentistry as a profession should incorporate objectives regarding sustainability into everyday practice and support the transition to green economy [8]. For oral health care providers, it should be an ethical obligation to perform medical activities in a sustainable manner [9].

To determine the carbon footprint of a dental practice, it is necessary to have information about the number of treatments, travel (both for staff and patients), energy and water use, and the amount of waste. The most significant part of a practice's carbon footprint is traveling, followed by dental treatments [6].

Sustainability means a sensitive and responsible use of natural resources, aimed at preventing depletion and maintaining ecological balance. Recycling helps reduce the depletion of natural resources needed for producing paper, plastic, and glass. Dental practices generate significant amounts of waste, including selective, household, food, and hazardous waste. It is the legal and professional responsibility of the medical team to manage waste appropriately and avoid environmental pollution [10,11].

The aim of the present study was to assess dentists' attitude regarding environmental awareness and exploring possible ways of reducing carbon footprint, as well as the feasibility of an environmentally conscious practice.

Methods

The present pilot study was based on an online questionnaire compiled by the authors. The questionnaire was designed based on scientific literature and 50 questions were formulated. The responses were recorded during September-November 2020. The questionnaire was distributed via e-mail to different regional Colleges of Dental Practitioners and was also available on social media dentist groups. The questionnaire was completed anonymously and voluntarily by dentists. Inclusion criteria: dentists who are members of the regional Colleges of Dental Practitioners and who have a right to practice. Questionnaires with incomplete answers were not included into the study.

The questionnaire was divided into the following sections: general data, travel, equipment, energy, waste generation and biodiversity.

The first part of the questionnaire referred to the location of the dental practice, the number of treatment units and the medical staff. Respondents were also asked if they were trying to live environmentally conscious in their own household.

The second group of questions was related to travel habits, methods of getting the supplies, dental laboratory, patients' residence, and environmentally conscious decisions regarding appointments.

The next section of the questionnaire included questions regarding the selection of the materials used, the type of the X-ray equipment, cleaning agents, redundant but still useful materials and the packaging of the products.

In the section related to energy, questions referred to the lighting, the electronic devices, air conditioning and possible self-produced energy.

Regarding waste generation, dentists were asked about selective waste collection, collection of expired drugs, paper use reduction, types of taps, rainwater collection, sterilization processes, amalgam fillings and defective equipment.

The last part of the questionnaire was related to biodiversity. These questions referred to: the existence of a green area, types of plants in the green area, herbicides used, bird feeders, the possibility of installing a green wall and growing vegetables or fruits near the practice.

Data were recorded in a Microsoft Excel spreadsheet. Statistical analysis was performed using GraphPad Prism 9.1.2 software. Descriptive statistics and Chi-square tests with Yates correction were used. The significance level was set at $p<0.05$.

Results

The questionnaire was completed by a total number of 98 dentists, mostly from dental practices in urban areas (79.41%) and less from rural (20.59%) areas.

The average distance between the responding dentists' home and workplace was 13.93 km. Most of the dentists are traveling by car (64.28%), followed by walking, cycling (21.42%), public transportation (13.26%) and electric cars (1.02%). When traveling, 12.24% of respondents are always paying attention to the environment, 38.77% are trying to pay attention, 46.93% are interested, but currently do not pay attention, and 2.04% do not know or don't care.

In more than half (62.24%) of the dental practices, the patients come from the same locality, in 14.28% from the surrounding area, in 16.32% from the whole country, and in 7.14% they are foreign patients. Most dentists (63.26%) do not want to draw the patients' attention to more environmentally conscious travel options, while 31.63% would do so, but there were few (5.10%) who had done so before. When arranging an appointment, 66.32% of the responding dentists plan to perform several treatments at the same time or give an appointment to family members one after the other because it is simpler and 13.26% because it can also protect the environment. In case of ordering the supplies, almost half of the respondents (45.91%) order mostly from one place, everything at once, and 37.75% order from several places.

The dental laboratory they work with is far from the

practice in approximately half of the cases (54.08%) and the daily work is sent once a day.

Figure 1 summarizes the results regarding questions about equipment and other supplies.

Materials that are no longer needed but could be useful later are kept in storage by 87.77% of the respondents, while 6.12% of them throw these materials away and 5.10% give them away as a gift.

The lighting in dental practices is mostly provided by light-emitting diodes (LED) in a proportion of 59.18%, followed by neon (12.24%), halogen (7.14%), neon and LED (6.12%), LED and halogen (2.04%) as well as traditional (2.04%) lighting, while 11.22% of respondents did not know what type of lighting they had in the dental setting. Regarding the reduction of paper waste, different methods are used, as seen in figure 2.

Reducing the use of disposable products was the most frequent answer regarding methods for achieving an environmentally friendly behavior in the practice among respondents (Figure 3).

Answers of the respondents for different issues from the questionnaire are expressed in percentages in table I and statistically significant differences regarding different issues are summarized in table II and table III.

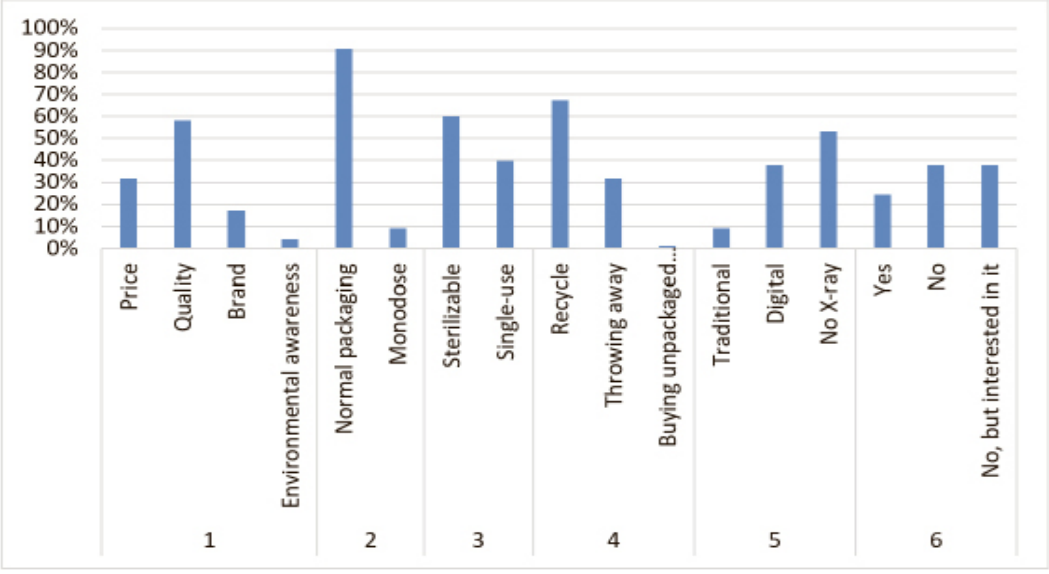

Figure 1. Distribution of answers regarding equipment and other supplies.
Legend: 1- Important aspects when purchasing; 2- Quantity; 3- Frequently used accessories (e.g., impression trays); 4- Product packaging; 5- Type of X-ray in the dental office; 6- Use of environmentally friendly cleaning products.

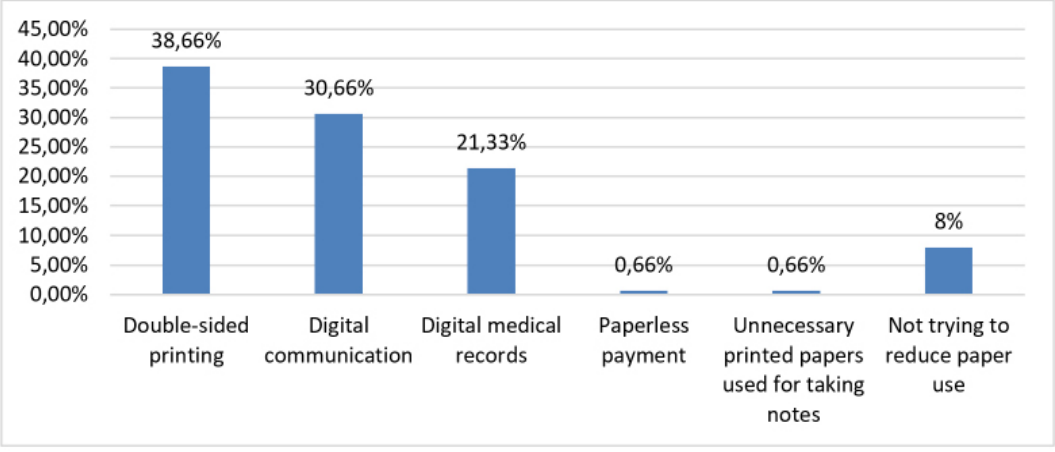

Figure 2. Distribution of answers regarding paper use reduction possibilities.

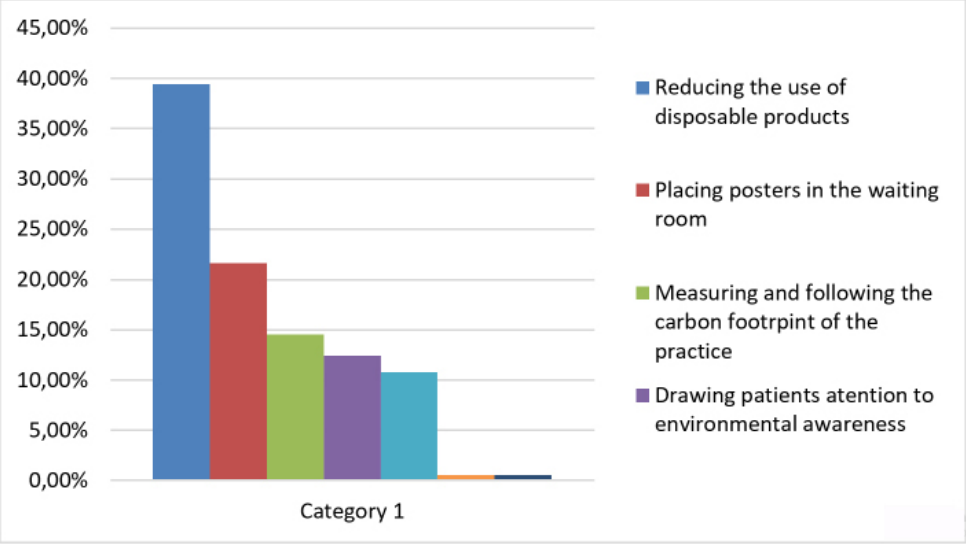

Figure 3. Methods of achieving an environmentally friendly behavior in the dental practice.

Table I. Distribution of participants' responses.

Main issues of the questionnaire	Yes	No	No, but interested
The idea of environmentally conscious behavior arose in connection with the practice	74.49%	25.51%	-
Trying to live in an environmentally conscious way in the household	94.89%	5.10%	-
Already counted the own ecological footprint	13.26%	44.89%	41.83%
Travelling affects the carbon footprint of the dental office	55.10%	44.90%	-
Checking environmentally consciousness of the manufacturer	3.06%	67.34%	29.59%
Using environmentally friendly cleaning products in the dental practice	24.48%	37.75%	37.75%
The dental office is insulated	23.46%	76.53%	-
Air conditioner always working	75.51%	24.49%	-
The dental office has its own energy production	98.98%	1.02%	-
Non-infectious waste selectively collected	47.96%	52.04%	-
Expired medicines collected by the pharmacies	61.22%	28.57%	10.20%
Amalgam fillings applied	95.51%	4.08%	-
Rainwater is collected	3.06%	96.94%	-
The dental practice has a green area	44.90%	55.10%	-
Herbicides are used to maintain the green area	4.54%	95.45%	-
The dental office has a green wall	11.22%	27.55%	61.22%
Intention to grow vegetables or fruits in the green area of the practice	16.32%	83.67%	-

Table II. Comparison between the respondents according to their attitude.

Statistically significant differences between those who would-prefer (group 1) and who would not consider (group 2) an environmentally conscious dental practice, regarding the following issues:	*p value* (In all cases group 1 had more "yes" answers)
Living in an environmentally conscious way in the household	*0.004*
Using environmentally friendly cleaning products	*0.006*
Having a "green wall" (vertical garden)	*0.006*
Using energy efficient electronic devices	*0.03*
Non-infectious waste is separately collected	*0.0002*

Table III. The most significant differences between issues of the questionnaire.

Statistically significant differences between the following issues:		*p value*
A green area belongs to the practice	A "green wall" is needed more in the practice	*0.0001*
Number of units in the practice	X-ray most likely present in the practice when there are more units	*0.03*
Distance from home to the practice	Travelling method depends on it	*0.001*
Living in an environmentally conscious way in the household	Tries most likely to pay attention on environmentally conscious methods of travel	*< 0.00001*

Discussion

The pursuit of environmental awareness and the reduction of the carbon footprint is becoming more and more important around the world and is being addressed in more and more sectors. The feasibility of an environmentally conscious medical or dental practice and the mapping of the steps that can be taken to this end are also an important part of this endeavor [4,5]. The aim of the present study was to shed light on these aspects with the help of a survey among dentists.

Harford et al. have dealt in detail with the issue of sustainability and tried to draw the attention of healthcare professionals, especially dentists, to the possibility and a way of setting up an environmentally conscious practice, providing a large amount of advice [8]. The most comprehensive series of studies found in the scientific literature regarding carbon modelling, sustainability and waste in dental practice provide detailed description of each issue and possible solutions [6,8,10]. Recent studies presented a model of sustainable healthcare [12] and offered perspectives on managing sustainability in dentistry [13]. A systematic review showed through 66 studies from scientific literature that dental professionals are permanently working on reducing the environmental impact of dental practice throughout the world [14].

In dental practice, one of the most important factors is related to travel [15]. The transport of staff and patients to the clinic, the supply of materials and the transport of work between the dental laboratory and the clinic must be considered here. Patient travel can be reduced by giving family members close appointments, and, where possible, performing multiple treatments at once. In addition, it is recommended to settle with the technician and the material supplier on reducing the number of deliveries. To draw the attention of patients to more environmentally conscious travel, dentists could place posters or questionnaires (available electronically) in the waiting room. These could help the clinical staff to encourage patients to walk or ride a bike, so a bicycle parking lot in front of the clinic would also help. In addition, making an appointment by phone or online, as well as discussing questions and problems over the phone, could reduce the number of dental visits [8,12,16]. Most of the dentists in the present study tried or wanted to pay attention to environmental awareness while traveling, but only one third would bring this to the attention of patients. At the same time, most responding dentists intended to give family members one single appointment or perform multiple treatments in one session, not only protecting the environment, but making the work easier.

The production of materials and equipment has an impact on the environment, the cause being the use of raw materials and energy, common by-products that pollute the atmosphere, soil and water. The medical team can control the impact of their practice on the environment, by regularly checking what materials are really needed, trying to look for more environmentally friendly alternatives and working with suppliers who pay attention to the environment. It is recommended to buy less (only what is necessary), reduce the use of disposable products where possible, buy environmentally conscious products or buy from manufacturers who pay attention to environmental awareness: sustainable supply chain, ethical working conditions, and a publicly available list of chemicals and sources of raw materials. Paper usage can be reduced by double-sided printing, digital communication and by avoiding unnecessary printed documents. It is also recommended to reduce the use of chemicals, which is possible by using digital X-ray machines, suitable alternatives to amalgam fillings, and installing amalgam separators, but even by using environmentally friendly cleaning agents [8]. Respondent dentists rated environmental awareness less important in selecting the materials, as in other factors (quality, brand, price).

Reducing energy use in a practice and investing in self-produced energy would not only protect the environment but would also bring health and financial benefits to the practices [17]. It is recommended to insulate the practice building, close the doors and windows when it is not necessary to keep them open, avoid high-consumption electrical equipment and switch to "green" electronic devices, reduce the use of air conditioning. It is useful to switch to an electricity supplier that obtains energy from renewable sources or, if possible, to generate our own energy [8].

Incineration or landfilling of waste has a significant impact on the environment by emitting greenhouse gases

and polluting the air, soil, and water. It is important that non-infectious and infectious waste does not mingle, because the removal of infectious waste is much more burdensome for the environment [8,18,19]. Where possible, non-infectious waste should be collected selectively. Reducing paper usage, purchasing durable products, and repairing defective equipment is recommended, as well as properly disposing of expired medications (e.g., dispensing at a nearby pharmacy that collects them, patient information and collection programs organized by pharmacists) [20]. Reducing water use is also possible with the help of sensor faucets, sterilization started after the autoclave is full, and even by collecting rainwater [8].

Biodiversity is based on the diversity in which all living things interact with one other in an ecosystem. An ecosystem is a dynamic system in which all species are interdependent and affect each other, and we are no exception. Species diversity is important not only because it affects several other species, but it also provides resilience to changing conditions such as climate change, land use, and the spread of pathogens. Currently, biodiversity is collapsing globally due to extensive farming, habitat destruction and climate change. If possible, it is recommended to create a green area around the dental practice, where the local ecosystem can be supported by planting native, insect-friendly plants, avoiding herbicides, creating bird feeders and natural habitats (leaving branches, leaves). However, plants planted in the office are also useful. If possible, in the green area, but also in pots, it is recommended to grow vegetables and fruits (such as herbs, tomatoes, hot peppers) in the appropriate rooms of the practice (waiting room, reception, staff rooms), so food can be obtained up close and environmentally friendly. The green wall created in the surgery is not only environmentally friendly but can even reduce patients' anxiety if they are waiting for treatment in such a waiting room and supports smoking cessation [8,18,19]. It is also recommended to get the vegetables and fruits consumed from a local farmer and to draw the attention of patients to this [8]. Almost half of the participating practices have a green area, where they keep native plants, and most of them do not use herbicides to keep them tidy. In six cases, there was already a green wall in the practice.

In summary, the essence of a sustainable future, in dentistry as well as in other areas, is defined by the 4 Rs: Rethink, Reuse, Reduce and Recycle. Introducing sustainable procurement procedures could lead to further decarbonization and reduction of plastic waste [6,12,14,22]. Awareness is important in achieving sustainability in dentistry and in developing environmentally conscious behavior in dental practices. The lack of professional and public awareness, lack of knowledge and education, manufacturing, and disposal of materials, as well as other factors result in barriers to implementation of an environmentally conscious practice [6,23].

The limitations of the present study were the followings: the convenience sample, the lack of recording the full demographic data and the high number of questions, which might be an inconvenience for the responders and could lead to lower response rate.

Conclusions

Dentists are usually open to the idea of implementing an environmentally conscious practice. Those who pay attention to the environment in their daily lives and in their own households are more open to these same aspects regarding the dental practice as well. However, the present study revealed that those who were not necessarily aiming towards environmental consciousness, have already included some of these aspects in their everyday lives. This means that there are terms that are easy to meet. Implementing these ideas could have benefits for our planet, and could also benefit a dental practice financially.

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