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Factors Affecting Water Quality and Sustainability in Dental Practices in Greece

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Abstract: Good water quality, achieved with environmentally friendly means, is essential in ensuring the safe operation of a dental practice. Our aim was to evaluate procedures and protocols used by dentists for water quality and sustainability. Greek dentists (n = 206) participated in this questionnaire-based study. Statistically significant results ($p < 0.05$) have shown that (a) female dentists were more interested in additional information about water quality (87.5% vs. 71.8%), had water supply directly from the public network to the dental unit (68.8% vs. 73.8%), were more likely to disinfect surfaces between two appointments (97.7% vs. 88.0%) and were more likely to perform annual maintenance to the dental unit (66.3% vs. 57.9%). (b) More experienced dentists were also more likely to clean the waterline network of the unit with a large amount of fluid once a day (39.3–48.3%), had newer equipment, had more handpieces, and spent more time cleaning and disinfecting the unit (χ^2 = 26.21). (c) Dentists who have studied abroad were more likely to perform less strict antiseptic protocols while believing that their practices are environmentally friendly (χ^2 = 10.93). Dentists with some postgraduate education were more likely to have an assistant, know the active substance of the antiseptic, supply antiseptic to the handpieces automatically and maintain the dental unit annually (χ^2 = 7.24). (d) Dentists who practiced general dentistry were less likely to have an assistant and performed less strict protocols while they cleaned suctions with a large amount of fluid less often (χ^2 = 11.64). Dentists who practiced in a clinic (with employees) were more likely to have newer equipment, have an assistant and perform stricter water sustainability protocols. (e) Dentists with a higher annual income were also more likely to have an assistant, perform microbiological tests for the quality of the water of the unit, have a continuous water supply system and perform stricter protocols for water quality of the unit. Overall, less experienced (and younger) dentists are more informed about water quality legislation (27.6%) compared to more experienced and older dentists (13.2–17.5%). Gender, work experience, level of education and dental office characteristics are important factors determining water sustainability, waterlines, and equipment maintenance in dental practice. Dental associations should raise awareness regarding water quality and sustainability, investing in lifelong learning, while implementing protocols and green strategies.

Keywords: water quality; infection control; green dental practice; antiseptic protocols; handpieces; dental unit waterlines; water sustainability; environmentalism; eco-friendly water behavior

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1. Introduction

Sustainable entrepreneurship in the field of health depends on the breathing space that managers and employees give to nature and its resources [1]. The recent COVID-19 pandemic made the need to protect and restore natural resources and integrate human activities more effectively even more imperative [2]. The pandemic has raised awareness

of the interconnectedness of our own health and the health of ecosystems [3–5]. It is vital then that stakeholders of the field avoid becoming stuck in destructive habits of the past towards environmentalism and protect air, water, and natural resources [6–12].

Water pollution is a key driver of biodiversity loss [12,13] and has harmful effects on our health and environment [14]. Biodiversity is affected by the release of nutrients, chemical pesticides, pharmaceuticals, hazardous chemicals, municipal and industrial wastewater, and other wastes, including litter and plastics, into water resources [15]. Dental offices have long waterline networks. In the field of eco-friendly dental practices, the reduction of water waste and the quality of water in the waterline network of the office and the dental unit, but also the prevention of infections, are challenges that every dentist must face [16,17]. Increasingly, low water quality has been recognized as a possible cause of biohazards and the spread of infections in the dental office [18,19]. A biofilm that forms inside the pipes of a building could contaminate the entire water supply network of that building, including the dental office [20]. Furthermore, within the dental clinic, water spreads as an aerosol, increasing both bacterial spread and the risk of infection to all people in the premises [12,21–24]. Oral flora [25] and human pathogens (e.g., *Pseudomonas aeruginosa* [26], various Legionella species (*Legionella pneumophila*) [27,28], non-tuberculous Mycobacterium species (*Mycobacterium*) [29], *Helicobacter pylori* [30] and other microorganisms including unicellular algae, bacteria, fungi, and protozoa [16,31]) have already been isolated from dental unit water systems [32]. They can coat and colonize almost any material in the dental clinic [33,34], especially the suction tube [16], forming biofilms. Biofilms in dental clinics have been shown to form a hazardous bacterial deposit, which can become resistant to various disinfectants [23,35–37] and serves as a reservoir that can enhance the number of floating (planktonic) microorganisms in the water used for dental treatment [38–40].

The trend and attention to this important matter is growing, in part due to the increasing needs for workplace safety for both workers and patients [12,41]. Good water quality is an important factor in ensuring the quality and safe operation of the dental practice [31,42]. The water network participates in all clinical protocols, in the antisepsis and disinfection procedures, the operation of the dental unit as well as all other areas (doctor's office, waiting room, toilets, laboratory, rest room or kitchen). Infections in dental practices can occur very easily [13,43,44]. Therefore, there is considerable (and justified) attention to the sterilization protocols of dental instruments and handpieces [45], but less attention is usually paid to the treatment of water in the practice's network even though it participates in these protocols [46,47] and may even cause an erosion effect in oral metal prostheses [48].

Biofilms within the waterlines of dental clinics originate from one of two possible sources of contamination: from the internal piping system using a direct supply from the public network or from the patient's mouth [31,48]. The public water supply is not entirely sterile. Water circulating in the system of the city contains a diverse microbial flora which, depending on its type and concentration, is generally harmless to humans. However, under certain conditions, pathogenic microorganisms or opportunistic pathogens can reach the dental unit through the water supply chain [49]. The microbiological quality of the water samples collected throughout the city system does not necessarily correspond to the microbiological quality that could be detected at points closer to the dental practice [17,33,50–52].

According to the above, staff and patients are constantly exposed to risk of infection due to water installations [2–4,28,53,54]. Therefore, this study was carried out in dentists working in the vast area of Metropolitan Athens, the capital of Greece, during the third phase of the pandemic (March–October 2022), to investigate water quality procedures, maintenance issues of the water network and relevant equipment, educational needs, and proposals to form future eco-friendly water strategies. Water quality in the region of the study is controlled by EYDAP (Hellenic water supply and sewerage company of the capital) [55] and is considered as one of the best in Europe [56] with a performance of >99.8%, a value higher than the average scores of other Western European companies [57]. Our scope was to further analyze and evaluate factors influencing water sustainability practices of dentists in Greece. The research questions

were the following: 1. What are the equipment and practices that ensure water quality in dental offices? 2. How do equipment and water sustainability processes differ according to the characteristics of dental practice? 3. Which equipment and practices lead to the strongest dentists' perceptions of dental unit water quality?

2. Background of the Study

Procedures and Systems for Water Quality Control in the Handpieces and the Dental Unit

Bacteria populations can be spread during ongoing dental procedures when dentists are using high-speed handpieces [57–60] and come into direct contact with the wounds of the patient undergoing treatment [61]. There is a risk of water backflow into the dental unit waterline system from the handpieces known under the term of the suck-back phenomenon [62]. High-speed handpieces, in the deceleration phase of cutting, have a centrifugal suction effect that forces them to retract organic material especially from their head [27,63]. For this reason, many handpieces are equipped with special anti-retraction valves, which hold the suctioned material in the rotor [61]. These valves may not provide a perfect blockage (depending on how well the handpiece is maintained) and any leakage can lead to bacterial colonies inside the handpiece body [64]. This is an ideal environment for bacteria to grow, increasing the risk of cross-contamination. Consequently, all modern dental clinics need to have integrated disinfection systems [26,64,65].

There are various devices, materials, and filters within or in parallel connection with the dental unit, which make it possible to limit the risk of contamination of the water circulating within its piping: (1) Chlorine dioxide is a powerful and effective disinfecting agent capable of producing and maintaining safe drinking water through oxidation rather than a chlorination reaction [38]. (2) Reverse osmosis is the safest and most widespread water treatment system in the world and can guarantee absolute water purity for the dental unit [66]. The osmotic membrane can process water to the molecular size, making its characteristics optimal in terms of color, smell, and organoleptic purity. (3) Electrolysis apparatuses that use only the chlorine normally present in municipal water, such as the Poseidon-S system, an additive-free disinfectant system described in the study of Fujita et al. [67] can also control microbial contamination in contaminated dental unit waterlines [32]. (4) Positive relevant results can also be guaranteed with plasma devices [68] or (5) acoustic waves at high energy [69]. It was mentioned that the efficacy of acoustic waves in preventing *Streptococcus mutans* adhesion on dental unit waterlines can be important [12]. For surgical procedures, sterile saline or sterile water should be used as the coolant/irrigant. Conventional dental units cannot reliably provide sterile water even when equipped with independent water tanks containing sterile water because the water-carrying path cannot be reliably sterilized [65,70].

The guidelines on infection control in dental healthcare settings issued by the US Centers for Disease Control and Prevention [11] recommend that the level of the heterotrophic plate counts (HPCs) in dental unit water should not exceed 500 CFU/mL [71]. Moreover, the American Dental Association (ADA) has set a limit of $\leq$200 CFU/mL on the heterotrophic bacterial load in water from dental unit waterlines [72]. In the EU, however, there is no current guideline regarding a dental unit's waterlines, though in some countries the drinking water standard is used as a reference ($\leq$500 colony forming units (CFU)/mL of water heterotrophic bacteria) [63]. For this reason, dental units are designed to include (a) self-contained water systems (e.g., independent water tank) combined with chemical treatment (e.g., periodic or continuous chemical microbicide treatment protocols), (b) systems in parallel connection with one or more dental units within the same dental office that clean or treat incoming water to remove or inactivate microorganisms throughout the network and (c) combinations of these methods (Figure 1).

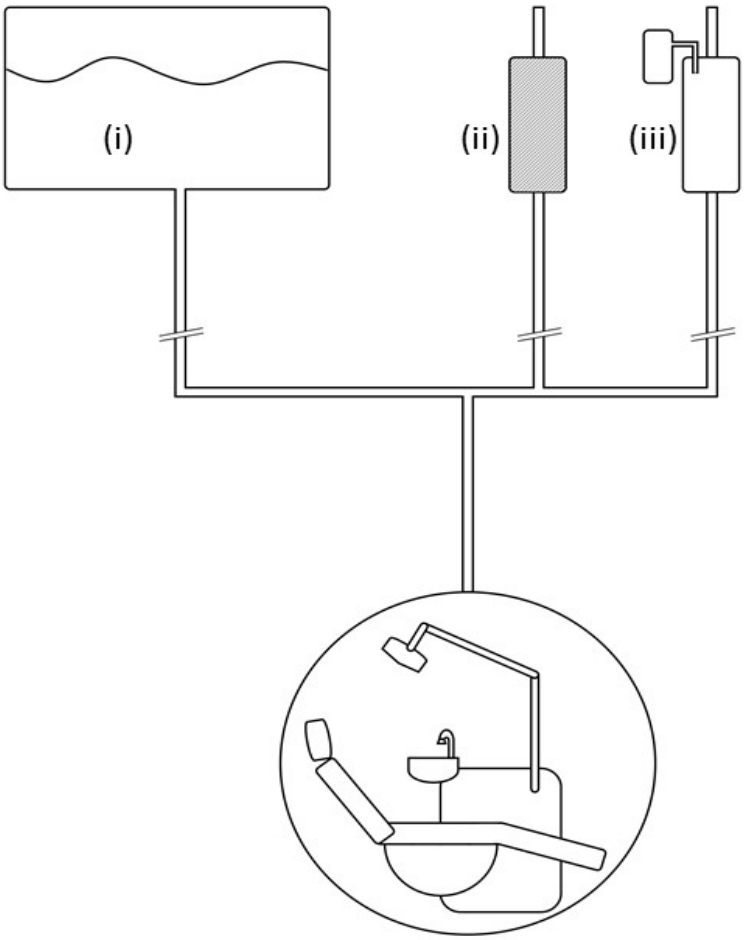

Figure 1. Graph showcasing various water treatment methods and arrangements within a dental practice: (**i**) Self-contained water systems (e.g., independent water tank) that supply the dental unit/s. (**ii**) Systems in line with one or more dental units within the same dental practice that filter incoming water. (**iii**) Systems in line with one or more dental units within the same dental practice that treat incoming water to remove or inactivate microorganisms throughout the network. These methods (**i–iii**) can also be used sequentially in line, e.g., tank combined with chemical treatment (periodic or continuous chemical microbicide treatment protocols) and filters.

When the treatment of patients is completed, specific protocols should be followed for flushing the suction network to reduce residual microbial contamination [12]. All incoming waterlines of the public water supply system within the dental practice (e.g., taps, dental unit water mains/waterlines and other dental equipment such as the suction mains) should be flushed [35,73]. There is no agreement on the optimal duration of flushing procedures, but the recommendations suggest that the procedures take from 1 to 5 min [74]. The time required may vary depending on the type and length of the network in the dental practice [11,64,74]. After flushing the incoming lines of the public water system, the dental facility waterlines should be disinfected according to manufacturer's instructions [28,31,54].

3. Research Method

3.1. Design and Validation of the Study Questionnaire

In this study, we used the questionnaire technique, which is a systematic method for data collection, and it has been already used to collect professional views on water sustainability attitudes before [24,26,54]. Standards assigned to the internal water network of modern dental units, explained before in the relevant review and shown in Figure 1, were used for the design of the study's e-questionnaire. More specifically, the questionnaire

consisted of three parts. Part A had nine questions concerning demographic statistics of the sample (gender, age, family status, place of work, dental educational level, ways of practicing dentistry, years of professional activity, family income) that were also mentioned in relevant studies as having a statistical impact in this sample [75,76]. Part B had thirty multiple choice questions describing ways of water circulation within the unit and handpieces, as well as attitudes and processes that dentists use for their maintenance, and disinfection as described in the previous review and elsewhere, too [77,78]. Part C had eight multiple choice questions addressing environmental and legislative issues based on current legislation directives [79,80]. Finally, part D had two questions about educational proposals on water quality assurance and the waterline network's maintenance within the dental practice. One of the questions was open-ended to describe participants' proposals and enquiries as mentioned elsewhere, too [75,76].

The validation procedure for the questionnaire consisted of an examination and filling-up procedure of the questionnaire by (a) 15 dentists working at the Department of Dentistry and 15 post graduate students, who voluntarily filled in the questionnaire and addressed issues of misconception, and (b) an independent panel of 6 experts in the field (a mechanical engineer and technician of dental units, 3 EYDAP experts and 2 dentists) reviewed and revised the survey questions to be relevant to the topic and expressed them correctly as mentioned elsewhere [81]. The members of the panel first worked alone and with the study team and then in a group with all the other experts. Necessary corrections were finally made to avoid possible misconceptions by participants.

The online questionnaire included a short introductory message describing the purpose of the study and stressing voluntary participation, confidentiality, and the right to refuse participation. Consent was obtained by asking participants to confirm that they agreed to complete the questionnaire by marking a "Yes, I agree to participate" box. Ethical approval was obtained from the Ethics and Scientific Board of the Athens Regional Dental Association, metropolitan area of the capital, No: 2660/08.12.2022. A QR code was assigned to the questionnaire link to provide direct access through participants' smartphones. The questionnaires required approximately 12–15 min to complete. Answering all questions was obligatory to submit the form, while submission was only allowed once. All participants were voluntarily filling in the form and no reward was given.

3.2. The Study Sample

The study sample consisted of professional dentists, active members of the Athens Regional Dental Association. Dentists were practicing dentistry in the vast Metropolitan area of Athens, Prefecture of Attica, Greece. Exclusion criteria consisted of undergraduate dental students, retired dentists, dentists working abroad, dentists not performing dentistry although members of the association and non-dentists. The link to the questionnaire was sent three times through the association's secretariat email list, once per week. The questionnaire was left open for 3 months. All members of the association had the same opportunity to participate in the study.

3.3. Statistical Analysis

The data collected from the survey were analyzed with the statistical package IBM SPSS v. 28. Absolute and relative frequencies (n, %) were calculated for all variables of demographic and dental practice characteristics, practices, and equipment for water quality. Following, to examine the associations between demographic and dental practice characteristics with adopted practices for water quality and equipment of dental offices, chi-square tests of independence were performed with Fisher's exact test correction when needed. To detect the most influential factors that lead to dentists' perception of good water quality in their dental practice, binary logistic regression analysis with backward elimination was performed with the dependent variable being the feeling of confidence about water quality and the independent variables being the adopted practices for water quality and equipment of dental offices. Stepwise backward elimination with a significance

level of .10 is commonly used in situations where multiple variables are available, and the aim is to select only the variables that provide a stable, generalizable model [82]. When recording practices, opinions and equipment, there is no need for a correlation between the responses (what is also called internal consistency or reliability) [83].

4. Results

In Table 1, data on demographics and dental practice characteristics are provided.

Table 1. Demographics and dental practice characteristics (n = 206).

		n	**%**
Gender	Men	117	56.8%
	Women	88	42.7%
	Other	1	0.5%
Family Status	Unmarried	48	23.3%
	Married	139	67.5%
	Other	19	9.2%
Age	up to 30 years	15	7.3%
	31–40	29	14.1%
	41–50	64	31.1%
	51–60	60	29.1%
	60+	38	18.4%
Workplace	Athens or urban center	190	92.2%
	Province	16	7.8%
Experience	0–10 years	32	15.5%
	11–20 years	59	28.6%
	21–30 years	57	27.7%
	30+	58	28.2%
Family Income	up to EUR 25,000	69	33.5%
	EUR 25,001–50,000	90	43.7%
	50,001 and above	39	18.9%
	I don't want to answer	8	3.9%
Education	Basic dental education in Greece	89	43.2%
	Basic dental education abroad	38	18.4%
	Postgraduate education	103	50.0%
	Recognized specialty	21	10.2%
Clinical activity	General dentistry	156	75.7%
	other activities	50	24.3%
Dental practice	private dental practice	136	66.0%
	dental clinic	57	27.7%
	Other	13	6.3%

Most dentists in our study (52.9%) do not have an assistant, were informed about water quality when acquiring the dental unit (61.2%) and are interested in learning more about water quality (78.6%). Yet only 55.3% reported that they were confident about the dental unit water quality regarding microbial load. A small percentage (21.8%) perform microbiological tests on the premises of the dental office. A continuous water supply system to the dental unit was reported by 30.1% of the dentists. A system of uninterrupted water supply to the handpieces and scalers, i.e., a feeding bottle that needs filling, was reported by 33.5% of participants. The water supply was mainly from the public network to the dental unit (65.0%), to the rotative cutting instruments (62.3%) and to ultrasonic and air-scaler devices (55.8%). Only about 25% of dentists reported that the water was filtered from a filter device directly connected to the supply. Dentists at a percentage of 55.8%

stated that the water was filtered in the dental office by a simple filter (19.4%), a reverse osmosis filter (4.9%), a deionization or ion-exchange filter (2.9%) or an activated carbon filter (15.0%). Participants further reported that the water filter is replaced or cleaned every 6 months (18.9%) or every 12 months (11.1%). Most dentists (71.8%) do not know the active substance of the antiseptic used for the hydraulic piping of the dental unit, while only 9.4% and 14.4% report that the antiseptic is supplied to the handpieces automatically or manually, respectively. A total of 96.1% of the participants were aware of an antiseptic liquid reservoir embedded in the dental unit.

Dentists reported being equipped with a strong surgical suction (94.7%), with an electric motor (67.0%) and air or water vacuum (8.8%), while 18.9% of dentists did not know the type of surgical suction of their unit. Before the COVID-19 pandemic, 82.6% of dentists reported cleaning the saliva suction with a small amount of fluid suctioning at least once a day. Also, 63.1% of dentists reported cleaning the saliva suction with a large amount of fluid suctioning at least once a day, and 27.7% reported that they performed this once a week. Regarding the surgical suction, 84.0% of dentists reported cleaning with a small amount of fluid suctioning at least once a day. Also, 59.8% of dentists reported cleaning the surgical suction with a large amount of fluid suctioning at least once a day, and 28.2% reported that they performed this once a week. Cleaning the waterline network of the dental unit with a large amount of liquid was reported at least once a day (46.1%) or every week (26.2%). Most dentists (91.7%) disinfected the surfaces of the dental equipment after each appointment.

The dental unit was reported to be serviced annually (or after a failure) by 61.6% of participants, while 38.4% only performed service after a failure. A total of 70.0% of dentists reported having up to three micromotors/luftmotors and 57.8% reported up to three airotors. Micromotors and airotors are cleaned between appointments by decontamination (58.30%), decontamination and sterilization (6.8%), sterilization (17.5%) or only surface cleaning (17.5%). A total of 37.6% of the participating dentists had an implantology motor. Most participants (53.8%) preferred channeling sewage into the sewer through suction compared to connection to the central drainage system. Possession of an amalgam separator was reported by 64.6% of dentists (type: unknown 19.9%, filter cleaning 28.2%, full replacement 14.1%). Having a contract with a collection company for medical waste and amalgam removal was reported by 58.2% and 26.6% of participants, respectively.

Only 14.4% of the participants declared being informed about water quality legislation in health care facilities. A total of 69.9% of dentists spend more than 2 h per month on the cleaning/disinfection of the dental unit. Moreover, 64.6% of dentists estimated spending up to EUR 50 per month for cleaning/disinfection of the dental unit. Thus, 84.6% of dentists believe that their practices for cleaning/disinfection of the dental unit are environmentally friendly. The implementation of the disinfection protocol was the dentist's own responsibility in 58.3% of cases, while 50.7% of participants reported adopting more strict practices of water management after COVID-19 (data available as Appendix A Table A1).

Following this, differences between demographic characteristics of dentists were examined. Table 2 presents only the significant results from the chi-square tests of associations performed between gender and variables of dentistry equipment and practices. Female dentists were more interested in additional information about water quality (females 87.5% vs. males 71.8%). Water supply directly from the public network to the dental unit, the handpieces and the ultrasonic devices was reported more frequently by female dentists (68.8% to 73.8%) compared to male dentists (51.8 to 58.3%). Moreover, female dentists were more likely to disinfect the dental office/equipment surfaces between two appointments compared to men (females 97.7% vs. males 88.0%). Also, female dentists were more likely to perform annual maintenance to the dental unit (females 66.3% vs. males 57.9%) and less likely to have an implantology motor (females 27.6% vs. males 44.6%).

Table 2. Differences between genders (male vs. female) in dentistry equipment and water quality practices.

		Female		Male		$\chi^2(p)$
		n	%	*N*	%	
Interested in learning more		77	87.50%	84	71.80%	7.35 (0.006)
Continuous water supply system cutters		22	25.00%	47	40.20%	5.17 (0.023)
Water supply to the dental unit	Water from public network	62	73.80%	67	58.30%	8.90 (0.012)
	Distilled/Deionized water	8	9.50%	7	6.10%	
	Water from a filter device directly connected to the supply	14	16.70%	41	35.70%	
Water supply to the handpieces	Water from public network	58	70.70%	66	56.90%	6.72 (0.035)
	Deionized/Distilled water	10	12.20%	11	9.50%	
	Water from a filter device directly connected to the supply	14	17.10%	39	33.60%	
Supply to ultrasonic scaler	Water from public network	55	68.80%	59	51.80%	10.31 (0.006)
	Distilled/Deionized water	14	17.50%	16	14.00%	
	Water from a filter device directly connected to the supply	11	13.80%	39	34.20%	
Disinf. Surfaces	between two patients	85	97.70%	103	88.00%	12.54 (0.028)
	every few appointments	0	0.00%	8	6.80%	
	per day	1	1.10%	6	5.10%	
	per week	1	1.10%	0	0.00%	
Annual maintenance		55	66.30%	66	57.90%	10.10 (0.018)
Has implantology motor		24	27.60%	52	44.40%	6.07 (0.014)

Table 3 presents only the significant results from the chi-square tests of associations performed between the dentists' work experience and variables of dentistry equipment and practices. More specifically, only 3.8–7.7% of dentists with less than 10 years of experience had a water filter to the dental unit, handpieces and ultrasonic scalers compared to 34.5–39.7% of dentists with over 30 years of experience. More experienced dentists were also more likely to clean the surgical suction with a large amount of fluid suctioning once a day (39.3–48.3%) compared to less experienced dentists who cleaned it likewise once per week (31.0%) or never (13.8%). Also, 61.1% of dentists with over 30 years of experience performed cleaning of the dental unit with a large amount of fluid suctioning at least once a day, while less experienced dentists were more likely to clean it once a week. More experienced dentists were also more likely to have more micromotors ($\chi^2 = 25.92$, $p < 0.05$) and airotors ($\chi^2 = 29.17$, $p < 0.05$) and spent more time cleaning and disinfecting the dental unit ($\chi^2 = 26.21$, $p < 0.05$). Yet, less experienced (and younger) dentists are more informed about water quality legislation (27.6%) compared to more experienced and older dentists (13.2–17.5%).

Table 4 presents only the significant results from the chi-square tests of associations performed between the dentists' educational characteristics and variables of dentistry equipment and practices. Dentists who have studied abroad were more likely to supply antiseptic to the handpieces manually ($\chi^2 = 7.15$, $p < 0.05$), clean the surgical suction with a small amount of fluid suctioning once per day and not between appointments ($\chi^2 = 13.26$, $p < 0.05$) and believe that their practices are environmentally friendly ($\chi^2 = 10.93$, $p < 0.05$). Dentists who had some postgraduate education were more likely to have an assistant ($\chi^2 = 13.66$, $p < 0.05$), know the active substance of the antiseptic ($\chi^2 = 5.86$, $p < 0.05$) and supply antiseptic to the handpieces automatically ($\chi^2 = 5.54$, $p < 0.05$). Also, most of the more educated dentists clean the surgical suction with a small amount of fluid suctioning between appointments (51.0% and 18.9%) compared to less educated dentists that clean the surgical suction with a small amount of water between appointments (40.7%) or once per day (35.2%), $\chi^2 = 13.26$, $p < 0.05$. Dentists who had some postgraduate education were more likely to maintain the dental unit annually ($\chi^2 = 7.24$, $p < 0.05$), have more micromotors ($\chi^2 = 12.72$, $p < 0.05$) and airotors ($\chi^2 = 8.94$, $p < 0.05$), have a contract for amalgam removal ($\chi^2 = 4.46$, $p < 0.05$) and were less likely to be responsible for the implementation of the disinfection protocol ($\chi^2 = 6.57$, $p < 0.05$). Finally, dentists with a recognized specialization were more likely to have an assistant ($\chi^2 = 5.56$, $p < 0.05$), maintain

the dental unit annually ($\chi^2 = 4.40$, $p < 0.05$), have less airotors ($\chi^2 = 22.76$, $p < 0.05$) and were more likely to not have an amalgam trap ($\chi^2 = 8.56$, $p < 0.05$).

Table 3. Differences between dentists' experience (in years) in dentistry equipment and water quality practices.

		Experience								
		0–10 Years		11–20 Years		21–30 Years		31 Years and Over		$\chi^2(p)$
		n	%	*n*	%	*n*	%	*N*	%	
Water supply to the dental unit	Water from public network	25	89.30%	36	63.20%	37	64.90%	32	55.20%	13.70 (0.033)
	Distilled/Deionized water	1	3.60%	7	12.30%	4	7.00%	3	5.20%	
	Water from filter	2	7.10%	14	24.60%	16	28.10%	23	39.70%	
Water supply to the handpieces	Water from public network	24	92.30%	37	62.70%	34	60.70%	29	50.00%	16.69 (0.010)
	Deionized/Distilled water	1	3.80%	9	15.30%	6	10.70%	6	10.30%	
	Water from filter	1	3.80%	13	22.00%	16	28.60%	23	39.70%	
Supply to ultrasonic scaler	Water from public network	21	80.80%	38	64.40%	32	58.20%	23	41.80%	13.63 (0.034)
	Distilled/Deionized water	3	11.50%	8	13.60%	7	12.70%	13	23.60%	
	Water from filter	2	7.70%	13	22.00%	16	29.10%	19	34.50%	
Large amount of water through surgical suction to the dental unit	between two patients	5	17.20%	0	0.00%	2	3.60%	8	15.10%	31.12 (0.008)
	every few appointments (3–4)	2	6.90%	5	8.60%	10	17.90%	7	13.20%	
	per day	9	31.00%	28	48.30%	22	39.30%	25	47.20%	
	per week or more	13	44.80%	25	43.10%	22	39.40%	13	24.60%	
Large amount of water to the dental unit	between two patients	4	16.00%	2	3.80%	4	8.30%	4	7.40%	27.69 (0.024)
	every few appointments (3–4)	1	4.00%	3	5.80%	2	4.20%	7	13.00%	
	per day	10	40.00%	11	21.20%	13	27.10%	22	40.70%	
	per week or more	10	40.00%	36	69.30%	29	60.40%	21	39.00%	
Micromotors	1	15	46.90%	18	30.50%	12	21.10%	6	10.30%	25.92 (0.011)
	2	5	15.60%	22	37.30%	19	33.30%	23	39.70%	
	3	3	9.40%	5	8.50%	9	15.80%	7	12.10%	
	4	3	9.40%	8	13.60%	3	5.30%	11	19.00%	
	5+	6	18.80%	6	10.20%	14	24.60%	11	19.00%	
Airotors	1	11	34.40%	8	13.60%	5	8.80%	5	8.60%	29.17 (0.004)
	2	10	31.30%	20	33.90%	17	29.80%	16	27.60%	
	3	1	3.10%	14	23.70%	5	8.80%	7	12.10%	
	4	3	9.40%	5	8.50%	11	19.30%	6	10.30%	
	5+	7	21.90%	12	20.30%	19	33.30%	24	41.40%	
Is informed about water quality legislation		8	27.60%	3	5.40%	7	13.20%	10	17.50%	8.34 (0.039)
Time Spent	no time	4	12.50%	0	0.00%	1	1.80%	0	0.00%	26.21 (0.002)
	up to 2 h per month	13	40.60%	13	22.00%	15	26.30%	16	27.60%	
	up to 4 h per month	10	31.30%	22	37.30%	14	24.60%	16	27.60%	
	more than 4 h	5	15.60%	24	40.70%	27	47.40%	26	44.80%	

In Figure 2, there is a graphical systemic presentation of factors affecting water maintenance of the dental unit.

Table 5 presents only the significant results from the chi-square tests of associations performed between the dental office characteristics and equipment/practices for water quality. Dentists who practiced general dentistry were less likely to have an assistant ($\chi^2 = 25.32$, $p < 0.05$), supply antiseptic to the handpieces manually ($\chi^2 = 4.56$, $p < 0.05$), clean the surgical suction with a large amount of fluid suctioning less often ($\chi^2 = 11.64$, $p < 0.05$) and have amalgam trap ($\chi^2 = 4.38$, $p < 0.05$). Dentists who practiced in a clinic (with employees) compared to a private practice were more likely to have newer equipment ($\chi^2 = 16.12$, $p < 0.05$), have an assistant ($\chi^2 = 44.26$, $p < 0.05$), supply antiseptic to the handpieces automatically ($\chi^2 = 6.36$, $p < 0.05$), have more micromotors ($\chi^2 = 31.40$, $p < 0.05$) and airotors ($\chi^2 = 22.04$, $p < 0.05$), have an implantology motor ($\chi^2 = 7.37$, $p < 0.05$), have a contract for amalgam removal ($\chi^2 = 4.07$, $p < 0.05$) and were less likely to be responsible for the implementation of the disinfection protocol ($\chi^2 = 26.24$, $p < 0.05$). Moreover, dentists with a higher annual income were more likely to have an assistant ($\chi^2 = 4.36$, $p < 0.05$), perform microbiological tests ($\chi^2 = 7.60$, $p < 0.05$), have a continuous water supply system to the dental unit ($\chi^2 = 6.38$, $p < 0.05$), supply antiseptic to the handpieces automatically ($\chi^2 = 6.21$, $p < 0.05$), clean the surgical suction with a small amount of fluid suctioning more often ($\chi^2 = 23.24$, $p < 0.05$), have more micromotors ($\chi^2 = 24.39$, $p < 0.05$) and were less likely to be responsible for the implementation of the disinfection protocol themselves ($\chi^2 = 6.26$, $p < 0.05$).

Table 4. Differences between dentists' educational characteristics in dentistry equipment and water quality practices.

		Education Abroad					Postgraduate Education					Recognized Specialty				
		No		Yes		$\chi^2(p)$	No		Yes		$\chi^2(p)$	No		Yes		$\chi^2(p)$
		n	%	*n*	%		*n*	%	*n*	%		*n*	%	*n*	%	
Has assistant		83	49.40%	14	36.80%	ns	41	35.70%	56	61.50%	13.66 (<0.001)	82	44.30%	15	71.40%	5.56 (0.018)
Knows the active substance of antiseptic		45	31.70%	13	39.40%	ns	25	25.50%	33	42.90%	5.86 (0.016)	55	35.00%	3	16.70%	ns
Antiseptic to the handpieces (auto)		15	9.90%	2	6.70%	ns	5	4.90%	12	15.20%	5.54 (0.019)	15	9.20%	2	11.10%	ns
Antiseptic to the handpieces (manually)		17	11.30%	9	30.00%	7.15 (0.008)	18	17.60%	8	10.10%	ns	25	15.30%	1	5.60%	ns
Small Suction	between two patients	80	50.00%	10	26.30%	13.26 (0.021)	44	40.70%	46	51.10%	13.04 (0.023)	85	47.80%	5	25.00%	ns
	every few appointments	25	15.60%	5	13.20%		13	12.00%	17	18.90%		28	15.70%	2	10.00%	
	per day	36	22.50%	17	44.70%		38	35.20%	15	16.70%		45	25.30%	8	40.00%	
	per week or more	19	11.80%	6	15.8%		13	12.00%	12	13.40%		20	11.20%	5	25.00%	
Annual maintenance		103	64.00%	19	51.40%	ns	58	53.20%	64	71.90%	7.24 (0.007)	114	64.00%	8	40.00%	4.40 (0.036)
Micromotors	1	38	22.60%	13	34.20%	ns	34	29.60%	17	18.70%	12.72 (0.013)	43	23.20%	8	38.10%	ns
	2	55	32.70%	14	36.80%		41	35.70%	28	30.80%		63	34.10%	6	28.60%	
	3	20	11.90%	4	10.50%		8	7.00%	16	17.60%		22	11.90%	2	9.50%	
	4	22	13.10%	3	7.90%		17	14.80%	8	8.80%		24	13.00%	1	4.80%	
	5+	33	19.60%	4	10.50%		15	13.00%	22	24.20%		33	17.80%	4	19.00%	
Airotors	1	21	12.50%	8	21.10%	ns	21	18.30%	8	8.80%	8.94 (0.063)	20	10.80%	9	42.90%	22.76 (<0.001)
	2	49	29.20%	14	36.80%		36	31.30%	27	29.70%		54	29.20%	9	42.90%	
	3	21	12.50%	6	15.80%		16	13.90%	11	12.10%		27	14.60%	0	0.00%	
	4	21	12.50%	4	10.50%		16	13.90%	9	9.90%		25	13.50%	0	0.00%	
	5+	56	33.30%	6	15.80%		26	22.60%	36	39.60%		59	31.90%	3	14.30%	
Has amalgam trap		106	65.80%	22	59.50%	ns	70	63.60%	58	65.90%	ns	121	68.00%	7	35.00%	8.56 (0.003)
Has contract for amalgam removal		42	27.30%	9	23.70%	ns	22	20.60%	29	34.10%	4.46 (0.035)	48	28.10%	3	14.30%	ns
Environment-friendly practices	A little	26	17.20%	2	6.50%	10.93 (0.012)	18	17.10%	10	13.00%	ns	28	17.10%	0	0.00%	ns
	Satisfactory	73	48.30%	12	38.70%		48	45.70%	37	48.10%		76	46.30%	9	50.00%	
	Enough	41	27.20%	9	29.00%		30	28.60%	20	26.00%		43	26.20%	7	38.90%	
	Very much	11	7.30%	8	25.80%		9	8.60%	10	13.00%		17	10.40%	2	11.10%	
Implementation of disinfection protocol is my responsibility		99	58.90%	21	55.30%	ns	76	66.10%	44	48.40%	6.57(0.010)	111	60.00%	9	42.90%	ns

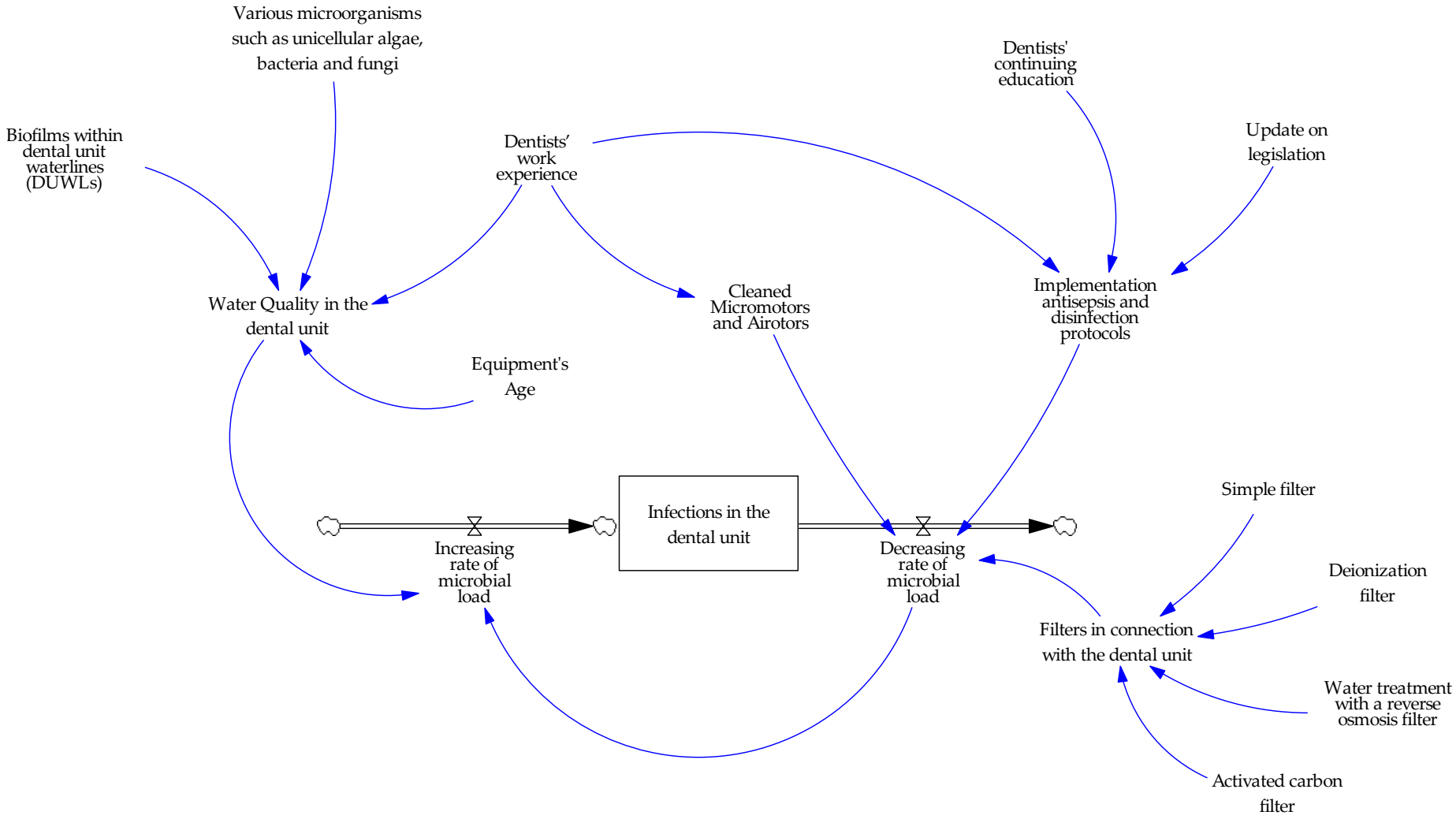

Figure 2. Systemic schematic presentation of factors affecting water maintenance of a dental unit.

Table 5. Differences dental office characteristics in dentistry equipment and water quality practices.

		General Dentistry					Clinic vs. Private Practice					Family Income					
		No		Yes		$\chi^2(p)$	No		Yes		$\chi^2(p)$	EUR < 25.000		25.001–50.000 €		EUR > 50.000		$\chi^2(p)$
		n	%	*n*	%		*n*	%	*n*	%		*n*	%	*n*	%	*n*	%	
Equipment age	0–5 years	12	24.00%	31	19.90%	ns	30	19.90%	13	23.60%	16.12 (0.001)	19	27.50%	11	12.20%	10	57.50%	ns
	6–10 years	13	26.00%	28	17.90%		21	13.90%	20	36.40%		12	17.40%	17	18.90%	11	30.30%	
	11–20 years	17	34.00%	71	45.50%		70	46.40%	18	32.70%		30	43.50%	44	48.90%	11	30.30%	
	21 and above	8	16.00%	26	16.70%		30	19.90%	4	7.30%		8	11.60%	18	20.00%	7	15.20%	
Has assistant		39	78.00%	58	37.20%	25.32 (<0.001)	50	33.10%	47	85.50%	44.26 (<0.001)	22	31.90%	45	50.00%	27	66.70%	14.36 (<0.001)
Performs microbiological test		13	26.00%	32	20.50%	ns	33	21.90%	12	21.80%	ns	17	24.60%	13	14.40%	14	56.10%	7.60 (0.022)
Continuous water supply system to dental unit		15	30.00%	47	30.10%	ns	41	27.20%	21	38.20%	ns	16	23.20%	26	28.90%	18	48.50%	6.38 (0.041)
Antiseptic to the handpieces (auto)		6	13.60%	11	8.00%	ns	8	6.10%	9	18.40%	6.36 (0.012)	8	14.00%	3	3.80%	6	16.10%	6.21 (0.045)
Antiseptic to the handpieces (manually)		2	4.50%	24	17.50%	4.56 (0.033)	19	14.40%	7	14.30%	ns	9	15.80%	10	12.50%	6	16.10%	ns
Clean suctiotion Large Small	between two patients	21	45.70%	69	45.40%	ns	63	44.10%	27	49.10%	ns	27	40.30%	39	46.40%	0	45.50%	23.24 (0.010)
	every few appointments	3	6.50%	27	17.80%		24	16.80%	6	10.90%		13	19.40%	9	10.70%	1	18.20%	
	per day	13	28.30%	40	26.30%		38	26.60%	15	27.30%		13	19.40%	30	35.70%	5	15.20%	
	per week or more	9	19.5%	16	10.6%		18	12.6%	7	12.7%		14	20.9%	6	7.2%	6	12.1%	
	between two patients	4	8.50%	11	7.40%	11.64 (0.040)	8	5.60%	7	13.00%	ns	6	9.10%	3	3.60%	8	6.10%	ns
	every few appointments	3	6.40%	21	14.10%		14	9.90%	10	18.50%		9	13.60%	12	14.30%	1	9.10%	
	per day	24	51.10%	60	40.30%		61	43.00%	23	42.60%		20	30.30%	38	45.20%	0	63.60%	
	per week or more	16	34.00%	57	38.30%		59	41.50%	14	25.90%		31	47.00%	31	37.00%	8	38.00%	
Micromotors	1	9	18.00%	42	26.90%	ns	46	30.50%	5	9.10%	31.40 (<0.001)	23	33.30%	20	22.20%	15	18.20%	24.39 (0.002)
	2	19	38.00%	50	32.10%		58	38.40%	11	20.00%		20	29.00%	39	43.30%	3	24.20%	
	3	5	10.00%	19	12.20%		16	10.60%	8	14.50%		9	13.00%	12	13.30%	11	9.10%	
	4	4	8.00%	21	13.50%		15	9.90%	10	18.20%		8	11.60%	8	8.90%	4	15.20%	
	5+	13	26.00%	24	15.40%		16	10.60%	21	38.20%		9	13.00%	11	12.20%	0	33.30%	
Airotors	1	10	20.00%	19	12.20%	ns	24	15.90%	5	9.10%	22.04 (<0.001)	13	18.80%	13	14.40%	2	6.10%	ns
	2	16	32.00%	47	30.10%		53	35.10%	10	18.20%		23	33.30%	28	31.10%	1	30.30%	
	3	6	12.00%	21	13.50%		23	15.20%	4	7.30%		9	13.00%	15	16.70%	14	3.00%	
	4	5	10.00%	20	12.80%		19	12.60%	6	10.90%		9	13.00%	10	11.10%	6	15.20%	
	5+	13	26.00%	49	31.40%		32	21.20%	30	54.50%		15	21.70%	24	26.70%	6	45.50%	
Has implantology motor		17	34.70%	60	38.50%	ns	48	32.00%	29	52.70%	7.37 (0.007)	28	41.20%	28	31.10%	0	45.50%	ns
Has amalgam trap		25	52.10%	103	68.70%	4.38 (0.038)	90	62.50%	38	70.40%	ns	46	71.90%	54	61.40%	38	62.50%	ns
Has contract for amalgam removal		10	21.70%	41	28.10%	ns	32	22.70%	19	37.30%	4.07 (0.044)	16	27.10%	21	23.90%	20	34.40%	ns
Money Spent	<25 EUR/month	11	22.00%	33	21.20%		37	24.50%	7	12.70%		21	30.40%	18	20.00%	5	12.10%	
	25–50 EUR/month	18	36.00%	71	45.50%		73	48.30%	16	29.10%		30	43.50%	42	46.70%	8	30.30%	
	50–75 EUR/month	9	18.00%	29	18.60%		24	15.90%	14	25.50%		10	14.50%	14	15.60%	3	36.40%	
	>75 EUR/month	9	18.00%	18	11.50%		12	7.90%	15	27.30%		6	8.70%	12	13.30%	1	18.20%	
Implementation of disinfection protocol is my responsibility		19	38.00%	101	64.70%	11.14 (<0.001)	104	68.90%	16	29.10%	26.24 (<0.001)	49	71.00%	47	52.20%	0	54.50%	6.26 (0.044)

Finally, when questioned about the environment friendliness of the dental office "*how environmentally friendly would you judge your practices in the dental office?"*, only 13.3% were a little satisfied with their practices, 25.2% were enough satisfied and 40.5% were satisfied. Of the participants, 42.9% have tightened their water practices due to COVID-19, while 47.6% have kept the same protocols as before COVID-19. When they were asked whether they would like to participate in voluntary actions for the quality assurance of the water, 49.5% responded negatively. Regarding the open-ended question, there were answers ranging across the environmental friendliness and awareness spectrum: "*We have a question of survival. Water does not concern me", or "I consider plastic to be a more important issue than water", or "I do not think it is possible to reduce water waste", or "it should be mandatory to install biological filters in the dental equipment and the network of the clinic", or "there should be a hygiene committee independent of the association to be able to carry out checks in dental practices and a clear legal framework that applies to the whole country territory".* Continuing education on the matter should be carried out by the associations (51%), sharing of relevant articles (45.7%) and workshops (40.5%).

5. Discussion

In this study, we searched for differences in processes and practices towards water quality and sustainability in the dental practice, maintenance of the relevant waterline network and relevant educational needs for professional dentists in Greece. To our best knowledge, there are a few studies presenting these issues according to certain demographic characteristics. To begin with, concerning gender differences found in our data, it is reported elsewhere that female dentists have different work patterns than their male colleagues [83–88]. This is assigned to psychological dissimilarities [89], as well as certain differences in their practical skills and roles within society [86,90–93]. Women, being culturally responsible for housekeeping [94,95], are more willing to perform accurate cleaning of the dental unit as already mentioned before [96]. In our study, female dentists were more interested in additional information about water quality, were more likely to disinfect the equipment between two appointments and were more likely to perform annual maintenance of the unit. In another study of female dentists, it was mentioned that they provide more scaling and restorative services than males although the differences might not be statistically significant [97] as in our study. This could also explain our findings, because after scaling it is known that the unit brings high levels of contaminant material into the system through blood suction during the process [49], thus forcing dentists to perform a stricter disinfection protocol. As reported in the study of Reza et al. [97], female dentists administered more pediatric treatments than their male colleagues, though this was not statistically significant. In our study, women were also less likely to have an implantology motor, indicating procedures other than implantology procedures being performed in their offices. Also, female dentists in our study were less willing to perform technical procedures for the equipment as in many cultures this is a male's role [98], and secondly, they usually have no time in between their other social roles [99]. Thus, it is not surprising that in our study they just directly connect their unit to the public water network and use no filters while men are searching for different solutions (filters, equipment, etc.) for achieving a better quality of water for the unit.

Furthermore, experience in the profession is a statistically important factor in our study. There are certain differences in the knowledge level among professionals as discussed elsewhere, too [99,100]. We found that more experienced professionals are more likely to follow high quality water performance strategies such as the use of a filter device directly connected to the main supply, flushing the suction and the unit once per day with a large amount of water and searching for extra water quality equipment, while less experienced ones preferred the simplest methods for the water supply such as a direct connection to the public water network and flushing once per week. It is unclear whether this attitude is based on the concern of saving water rather than ignorance of safe antiseptic protocols. Further, as evidenced by the literature, transmission within the dental practice via direct

contact is possible with the use of hollow instruments in dentistry [34,48]. So, effectively enough, more experienced dentists in our study had more micromotors and airotors and spent more time cleaning the unit, diminishing cross-contamination possibilities between appointments as reported elsewhere, too [28,101].

Several studies can report on the efficacy of methods to clean and disinfect hollow instruments such as airotors and (high-speed) handpieces [44,60,102,103]. The presence of bacteria, fungi, and viruses on and inside hollow dental instruments has been determined before [18]. Cleaning these handpieces with a wipe moistened with ethanol (70%) is insufficient to eradicate microbial contamination [104]. As known from all relevant COVID-19 protocols, it is not only the exterior but also the interior of these instruments that should be cleaned and disinfected properly, because hollow instruments contain contamination of both the patient and the water/air supply [62,101]. Moreover, sufficient guidelines about how to decontaminate handpieces are available [19], but most of the dentists in our study and elsewhere [105,106] are unaware of these guidelines, forgetting, for example, that overnight bacterial accumulation in the handpieces can be significantly reduced by allowing water-cooled handpieces to run and to discharge water into a sink or container for several minutes at the beginning of the clinic day [101]. In the study of Schalli et al. [101], though, the fact that 92.9% of water samples taken after procedures during which no spray water was used showed an increase in protein concentration illustrates that the contamination cannot be due solely to the retraction of spray water and that differences in the maintenance and antiseptic protocols used in different offices and the rotational speed of the handpiece could explain a certain dilution [44,49,103]. Other techniques such as preprocedural mouth rinsing with chlorhexidine [107], essential oil, povidone-iodine or water before ultrasonic scaling could reduce bacterial contamination on aerosol formation and cross-contamination [60]. Finally, researchers seem to agree that the extent of contamination can depend on the person using the instrument, also proven from our data, as well as on the patient [45]. Additional relevant factors include the number of motor stops, the rotational speed of the handpiece (controlled using the foot pedal), the extent of the lesion to be treated and the oral hygiene of the patient. In the study of Schalli et al. [101], it was discussed that six out of seven offices had contaminated spray-water lines even before patients were treated with the handpieces. Only in the case of instruments in the office where thorough decontamination, including disinfection, had been performed was no protein measurable before treatments [101]. An exact documentation of the decontamination procedures and storage conditions, as well as an analysis of the disinfectants and lubricants used, should be assigned for a further update of the procedures [45]. In our study, unfortunately, only 28.2% of the dentists knew the active substance of the antiseptic they were using.

Individual handling of the instruments from assistant personnel or the dentist himself is essential, too, and from our data, dentists studying abroad and those performing general dentistry are more informed on performing four-hand dentistry for a better antimicrobial scene and health for personnel and the patient as also described elsewhere [18]. Further, dentists in our study with some postgraduate education were more likely to have annual maintenance habits for their equipment and unit, have more handpieces and have a contract with a certified disposal company for amalgam removal. Also, it was less likely for them to be responsible for the implementation of the disinfection protocol as they work with an assistant. This is also reported elsewhere, where there are significant differences in the knowledge scores between different groups of dental professionals and between dental specialists and dental assistants, too [99,100,106]. The trend for specialists and more educated dentists is to work on a team basis and run larger clinics with more than one unit, as was the case in our study, too. In such a scenario, assistants can run safe protocols in between appointments, presenting a safer antiseptic profile.

In our study, dentists that had studied abroad supply antiseptic to the handpieces manually and clean the suction with a small amount of fluid and not between appointments, believing falsely that their practices are environmentally friendly. This is attributed to differences in educational approaches in different countries and regions as mentioned else-

where [108]. In larger dental clinics, though, equipment is newer, the supply of antiseptic to the handpieces is automatic and they have more handpieces, implantology motors and contracts with amalgam disposal companies. Economic reasons for performing cheaper and not environmentally friendly safety protocols in the practice are also reported elsewhere [109]. But the cheap protocol is not scientifically based, nor is it safe. It can even be more expensive even in a short-end period. Patients are well informed after the COVID-19 pandemic on the safety protocols and are willing to support health units that practice these protocols [103,109]. Dentists that do not follow certain antiseptic and equipment maintenance guidelines will disappoint stakeholders sooner than in the past and they will most likely encounter sustainability issues [12].

Thus, the Centers for Disease Control and Prevention [19] recommend that manufacturers should provide dental units with a separate reservoir, typically a container of about 1 L capacity, from which tap water, deionized water and/or distilled water can be fed to the handpiece, which is the case in our study, as 96.1% of participants reported having an antiseptic reservoir embedded in the dental unit compared to 94% in East England reported before [110]. This can also be applied to the use of biocides. In cases where dental units are still fed directly by municipal water, it is even more important to adopt the various systems for preventing microbial contamination, such as, for example, the use of handpieces and turbines fitted with anti-reflux valves or flushing, which should always be carried out for 20–30 s after each patient is treated [35,73]. Of course, flushing with water alone cannot guarantee water quality in the practice as shown in the study of Alkhulaifi et al. [73]. Unfortunately, though, most dentists in our study (71.8%) do not know the active substance of the antiseptic used for the hydraulic parts of the dental unit, a point that needs further attention for continuing education courses in the field. Baudet et al. [111] found that tap water is used in the dental unit by 65% of the dentists, distilled water by 2.3% and filtered water by 19.7% compared to our 89%, 3.6% and 7%, respectively. Additionally, Chate [110] reports that water is tested by 1% of dentists, Baudet [111] reports 2.6%, whereas we found that 21.8% perform water testing compared to 16.8% in the USA [110] and 17% in the EU, reaching as high as 70% in Germany [111]. In our study, it was reported that filters are replaced every 6 months by 18.9% of dentists and every 12 months by 11.1%, and both values are lower than what Baudet has reported [111].

Overall, as already discussed in the guidelines for the prevention and control of legionellosis [11,12,112], in order to reduce microbial contamination and/or the formation of biofilm in dental waterlines, the following recommendations should be implemented: (a) any sections excluded from the flow currents should be eliminated from the network, (b) anti-stagnation devices should be installed to keep the water circulating continuously, particularly during non-working hours, (c) sterile solutions should run through the network, after isolating it from the main water supply, (d) slow dentistry and long appointments on the same patient as well as intervals between patients (as suggested by the COVID-19 pandemic) should be followed, (e) all devices that connect to a waterline and enter patients' mouths (handpieces, ultrasonic scalers and air/water syringes) should experience sterilization and switched to the hoses after the final system is flushed before use for at least two minutes at the beginning of each working day and for at least 20–30 s before each patient, (f) filters ($\leq$0.2 μm) that can trap microorganisms coming from inside the water supply network should be installed immediately upstream of handpieces, (g) in the case of invasive surgical procedures with implantology motors, only sterile water should be used, and the supply network should also be sterile, and (h) if sterility of the dental unit's supply network cannot be guaranteed, a bypass system should be created and disposable sterile devices, or sterilizable devices, should be used.

Young dentists should invest in green water strategies, revised protocols and comparative legislation addressing four-handed dentistry even at the beginning of their career. Successful and green water sustainable dental practice can be the scope of not only those managing large clinics but also dentists who are less educated or specialized. The largest impact factor in the dental practice for water sustainability is the human factor, the profes-

sionals themselves, their overall education, knowledge on water quality, experience, and willingness to invest in green procedures that may seem or are more expensive [12,113–116]. Dentists should be dedicated to excellency and constantly invest in revised continuing education on water sustainability and eco-friendly knowledge, financing relevant equipment opportunities and education for themselves and the auxiliary staff. They should also invest in slow dentistry procedures with better time management and revised water maintenance protocols. Professionals should finally decide on withdrawing old equipment not corresponding to green standards with governmental financing as conducted in other fields of green buildings' philosophy [76].

6. Conclusions

Our findings suggest that authorities should conduct workshops, training sessions and seminars to raise the awareness on water quality and waste in Greek dental practices, especially to general dentists and dentists having studied abroad. Water quality in the dental office is a big issue depending on the unit, the waterline network, the use of filters, the age and type of the equipment, the procedures, materials, and other demographic factors such as gender, age, experience, educational and economic status of the dentist, specialty, and dental practice characteristics.

Limitations of the present study that should be taken into consideration for future coverage include the requirement for a far larger sample in the whole Greek territory, to overlook residence differences (urban vs. non-urban offices) because urbanism seems to affect environmentalism [76]. Also, the present questionnaire should be further enriched with questions based on the socio-environmental and economical capacity of participants to incorporate water sustainability procedures and equipment into their practice, their overall habits on environmentalism and their present culture on green dentistry and water eco-friendly dental practice. Due to the subjective nature of the questionnaire, the study should be repeated after an information-based campaign through the official network of the association to address possible changes in dental practices' sustainable water eco-culture.

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Institutional Review Board Statement: The study was conducted in accordance with the Declaration of Helsinki and approved by the Scientific Board of the Athens Regional Dental Association (No: 2660/8 December 2022).

Informed Consent Statement: Informed consent was obtained by filling out the questionnaire. The investigation was based on an anonymous online survey with explanations posted in the accompanying email and introduction section of the survey. Submitted responses were considered as obtained informed consent.

Data Availability Statement: Data supporting reported results can be found in Appendix A.

Conflicts of Interest: The authors declare no conflict of interest.

Appendix A. Descriptive Statistics of Dentistry Equipment and Water Quality Practices (*n* = 206)

Table A1. Descriptive statistics of dentistry equipment and water quality practices (*n* = 206).

		n	%
Equipment How Old	0–5 years	43	20.90%
	6–10 years	41	19.90%
	11–20 years	88	42.70%
	21 years and older	34	16.50%
Has assistant	No	109	52.90%
	Yes	97	47.10%
Was informed when acquiring	No	80	38.80%
	Yes	126	61.20%
Interested in learning more	No	44	21.40%
	Yes	162	78.60%
Confident about water quality	No	92	44.70%
	Yes	114	55.30%
Performs microbiological test	No	161	78.20%
	Yes	45	21.80%
Continuous water supply system dental unit	No	144	69.90%
	Yes	62	30.10%
Continuous water supply system cutters	No	137	66.50%
	Yes	69	33.50%
Water supply to the dental unit	Water from public network	130	65.00%
	Distilled/Deionized water	15	7.50%
	Water from a filter device directly connected to the supply	55	27.50%
Water supply to handpieces	Water from public network	124	62.30%
	Deionized/Distilled water	22	11.10%
	Water from a filter device directly connected to the supply	53	26.60%
Supply to ultrasonic scaler	Water from public network	114	58.50%
	Distilled/Deionized water	31	15.90%
	Water from a filter device directly connected to the supply	50	25.60%
Has water filter	No	91	44.20%
	Yes	115	55.80%
Water filter replaced/cleaned	No filter/Don't want to answer	99	52.10%
	every month	5	2.60%
	every 6 months	36	18.90%
	every 12 months	21	11.10%
	every 2 years	9	4.70%
	every 5 years +	4	2.10%
	whenever there is a problem with the flow	16	8.40%
Knows the active substance of antiseptic	No	148	71.80%
	Yes	58	28.20%
Antiseptic to the incisors (auto)	No	164	90.60%
	Yes	17	9.40%
Antiseptic to the incisors (manually)	No	155	85.60%
	Yes	26	14.40%
Antiseptic reservoir	No	8	3.90%
	Yes	198	96.10%

Table A1. *Cont.*

		n	%
Has strong surgical suction	No	11	5.30%
	Yes	195	94.70%
Small suction	between two patients	78	39.60%
	every few appointments (3–4)	37	18.80%
	per day	55	27.90%
	per week	21	10.70%
	never before COVID-19	4	2.00%
	never again due to COVID-19 let patients flush	2	1.00%
Surgical suction	between two patients	18	9.00%
	every few appointments (3–4)	23	11.50%
	per day	89	44.50%
	per week	57	28.50%
	per month	6	3.00%
	Never	7	3.50%
Small Suction	between two patients	90	45.50%
	every few appointments (3–4)	30	15.20%
	per day	53	26.80%
	per week	14	7.10%
	per month	5	2.50%
	Never	6	3.00%
Surgical Suction	between two patients	15	7.70%
	every few appointments (3–4)	24	12.20%
	per day	84	42.90%
	per week	58	29.60%
	per month	7	3.60%
	Never	8	4.10%
Dental unit waterline	between two patients	14	7.80%
	every few appointments (3–4)	13	7.30%
	per day	56	31.30%
	per week	54	30.20%
	per month	16	8.90%
	Never	26	14.50%
Disinfecting Surfaces	between two patients	189	92.20%
	every few appointments (3–4)	8	3.90%
	per day	7	3.40%
	per week	1	0.50%
Annual maintenance	No	76	38.40%
	Yes	122	61.60%
Micromotors	1	51	24.80%
	2	69	33.50%
	3	24	11.70%
	4	25	12.10%
	5+	37	18.00%
Airotors	1	29	14.10%
	2	63	30.60%
	3	27	13.10%
	4	25	12.10%
	5+	62	30.10%
Handpieces Maintenance	Decontamination	120	58.30%
	Decontamination/Sterilization	14	6.80%
	Sterilization	36	17.50%
	Surface cleaning	36	17.50%

Table A1. *Cont.*

		n	%
Has implantology motor	No	128	62.40%
	Yes	77	37.60%
Via suction vs. central drain	No	79	46.20%
	Yes	92	53.80%
Has amalgam trap	No	70	35.40%
	Yes	128	64.60%
Has contract with medical waste collection company	No	82	41.80%
	Yes	114	58.20%
Has contract for amalgam removal	No	141	73.40%
	Yes	51	26.60%
Is informed about water quality legislation	No	167	85.60%
	Yes	28	14.40%
Time spent	no time	5	2.40%
	up to 2 h per month	57	27.70%
	up to 4 h per month	62	30.10%
	more than 4 h	82	39.80%
Money spent	EUR 0 per month	8	3.90%
	less than EUR 25 per month	44	21.40%
	EUR 25–50 per month	89	43.20%
	EUR 51–75 per month	38	18.40%
	more than EUR 75 per month	27	13.10%
Environmentally friendly practices	a little bit	28	15.40%
	Satisfactorily	85	46.70%
	Enough	50	27.50%
	very much	19	10.40%
Implementation of disinfection protocol is my responsibility	No	86	41.70%
	Yes	120	58.30%
Stricter after COVID-19	No	99	49.30%
	Yes	102	50.70%

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