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Assessment of Dentists' Existing Knowledge towards Triclosan and Its Impact on General Health

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Authors' contributions

This work was carried out in collaboration among all authors. All authors read and approved the final manuscript.

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ABSTRACT

Background: Triclosan is widely used in hygiene products. Recently, FDA has banned over-the-counter products containing triclosan due to its potentially harmful effects on health.
Aim: This study aimed to find dentists' knowledge regarding the ill effects of triclosan on general health, the status of any ban being imposed on triclosan around the world, and their knowledge of any alternatives available.
Methods: This cross-sectional study made use of a self-designed questionnaire to collect data. Two experts did face validity of the questionnaire, and six experts from Pharmaceutical Science did

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content validity. A total of 195 dentists' were administered the questionnaire utilizing a Google form.
Results: All participants filled out the questionnaire, of which 149 (76%) were males and 46 (23.5%) were females. 45% of dentists had experienced between 5-9 years and 39.4% had more than 10 years of experience. Eta correlation showed that the experience of the dentist had a 42% influence on their knowledge scores. Point-biserial correlation indicated that female dentists showed poor knowledge scores when compared to males.
Conclusion: The present study found that although dentists knew about triclosan, their knowledge regarding its safety was limited. There was mixed opinion regarding banning triclosan in the country. Considering the limited literature on the subject, this study serves as the first step to assess the awareness of the dental community towards triclosan.

Keywords: Triclosan; awareness; dentists; dental health surveys.

1. INTRODUCTION

Triclosan is a nonionic and relatively small molecule (289.54g/mol) that is extensively used in many personal care products. Since it is a broad-spectrum antibacterial agent, it is involved extensively in many products such as toothpaste, cosmetics, deodorant sticks, mouth rinses, dentifrice gels, and anti-bacterial [1]. The physical state of triclosan at standard temperature and pressure is white solid characteristic with a melting point of 54-57°C and boiling point of 280-290°C [2,3]. It has been demonstrated that triclosan at its bactericidal concentration can cause cell wall disruption of the bacteria with nonspecific targets. However, its action is limited on specific targets when used at sub-lethal concentrations [4]. Perencevich EN et al identified that Triclosan is alarmingly rising in terms of its production and consumption this can be understood by the fact that between 1999 and 2000, 75% of 178 liquid soaps sampled contained triclosan and 30% of over 300 samples of bar soaps contained triclosan [5]. This is just going to increase in the pandemic situation where hand washing is being encouraged with soap to have complete protection against microbes. The US Food and Drug Administration (FDA) in 2013 reported triclosan as an active ingredient, found in 93% of liquid, gel, or foam soaps [6]. Interestingly, triclosan-containing soap products were not found to provide any additional skin-sanitizing benefits compared to soap not containing triclosan [7].

In addition to this, the overexposure of the compound might even result in bacterial resistance [8]. This might also get associated with an elevation in resistance to multiple other antibiotics in clinical settings [9].

Caracciolo A, et al reported that triclosan was detected in water sewage, soil, and wastewater treatment influents, which could be attributed to the extensive use and physicochemical properties of triclosan that influence its persistence in the environment [10,11].

Above all in 2016, FDA issued a warning and ordered to withdraw any over-the-counter (OTC) triclosan-containing products and prohibited their manufacture for personal care uses [12]. Therefore, in recent years concerns have been raised and escalated about the presence of triclosan in many daily-use products, and its potential harmful impacts on human health and the environment [13]. As triclosan is also widely present in dentifrices and mouthwashes it is important to know dentists' perception and existing knowledge of triclosan and its effect on health.

This study is intended to find the dentists' knowledge regarding the ill effects of triclosan on general health, the status of any ban being imposed on triclosan around the world, and their knowledge of any alternatives available.

2. MATERIALS AND METHODS

Study Design and Study Setting: This cross-sectional online survey was conducted from May 2020 to July 2020. The subjects that were included in this study consisted of all the general dental practitioners who consented to participate in this online survey.

Sample size calculation: The sample size was calculated using GPower v.3.1.9.7, using alpha as 0.05, power 80%, and assuming that fifty percent of the dentists are aware of the triclosan and its effect on general health as there is no previous published literature on this topic. The minimum calculated sample size was 190. Convenience sampling was adopted to meet the necessary sample size.

Questionnaire Development and Assessment: Data was collected by using a Google form sent to the dentists through mail or messages. A self-designed, pre-tested, and validated questionnaire was used for the present survey, consisting of 14 questions, to assess the knowledge of dentists about triclosan and its effect on overall health. All the questions designed were close-ended and had undergone face validity, done by two experts who suggested reframing one of the questions among the total of 14 questions. After this, the content validity of the questionnaire was conducted by six experts constituting experts from Pharmaceutical Science, Periodontology, and Public Health Dentistry fields. Necessary corrections were made. The content validity ratio was calculated for all fourteen questions. The minimum value required for validation was 0.99. All questions scored more than 0.99 and hence were included in the study. This questionnaire underwent test-retest reliability where all the questions received high Cronbach's α scores of 0.91.

The responses to the questionnaire for every question had to be dichotomized under the heading correct and incorrect responses to apply appropriate statistical analysis; the questions asked were mostly evaluating the dentists' knowledge and each correct answer was scored with one point. The total highest correct score could be 14 for a candidate with 0 being the minimum response, the knowledge scores were hence divided into Good score (10-14), Fair score (5-9), and Poor score (0-4).

Statistical Analysis: Data were analyzed using IBM SPSS v.20. The skewed distribution of gender required separate percentage scores to be calculated for gender. The chi-square test was used to test the association of knowledge scores with gender and experience. Eta correlation was applied to test the association between gender and knowledge of the dentists, Point biserial test was used to test the association between experience and knowledge scores.

3. RESULTS

A total of 195 participants filled out the questionnaire, of which 149 (76%) were males and 46 (23.5%) were females. A total of 77 (39.4%) subjects were reported to have more than 10 years of experience (Table 1).

Table 2 depicts the distribution of dentists according to knowledge rating among the dentists. None of the female dentists were found to be aware of triclosan and its effect on body weight, 38.20% of males were aware, this difference was statistically significant. There was no difference in the knowledge rating among males and females towards triclosan being allergic to human beings with 68.4% of males and 67.3% of females responding correctly. The knowledge regarding triclosan and its influence on gingival inflammation was found to be similar for both groups of experience levels and the difference was not significant. 51.6% of dentists with less than 10 years of experience believed that triclosan can transmit from mother to child. Knowledge scores showed a significant difference when tested between the experience of the dentists'. Dentists with less experience presented better knowledge when compared to those with more experience. 42.2% of males reported good knowledge compared to 17.3% of females. Poor knowledge is being reported more among female dentists (26.0%) and dentists with more experience (35.5%) respectively (Table 3).

Out of the total variation in knowledge scores, the Eta correlation suggests that 42% of the variance can be attributed to the experience of dentists. A point-biserial correlation was run to determine the relationship between Knowledge scores and the Gender of the dentists. There was a statistically significant negative correlation. Lower levels of knowledge were associated with higher levels of group membership (Group membership allotted was {1=males}, {2=females} which indicates that female dentists showed poor knowledge scores when compared to males (Table 4).

Table 1. Demographic distribution of the study population

Variable		Subjects	Percentage
Gender	Male	149	76.4
	Female	46	23.6
Experience	≤10 years	118	60.5
	>10 years	77	39.5

Table 2. Correct responses in relation to gender and experience of the dentists towards every question

S.N	Questions with correct response	Gender N(%)		Chi-square	p-value	Experience N(%)		Chi-square	p-value
		Male 149 (76.4%)	Female 46 (23.6%)			≤10y 118 (60.5%)	>10y 77 (39.5%)		
1	Is Triclosan a constituent of mouthwash/ other personal care product?	130 (87.2)	31 (67.3)	9.63	0.003*	98 (83)	63 (82.8)	0.049	0.849
2	Can Triclosan influence body weight	57 (38.2)	0	24.87	0.0001*	46 (38.9)	11 (14.4)	13.74	0.0001*
3	Can Triclosan influence on fertility among males	82 (55)	17 (36.9)	4.59	0.042*	73 (61.8)	26 (34.2)	14.72	0.0001*
4	Can Triclosan influence on puberty among females	83 55.7)	23 (50)	0.46	0.504	78 (66.1)	28 (36.8)	16.61	0.0001*
5	Can Triclosan influence progesterone & estrogen	95 (63.7)	23 (50)	2.78	0.120	82 (69)	36 (47.3)	10.08	0.002*
6	Can Triclosan influence thyroid function	95 (63.7)	18 (39.1)	8.75	0.004*	76 (64.4)	37 (47.3)	5.12	0.027*
7	Can Triclosan influence gingival inflammation	90 (60.4)	20 (43.4)	4.09	0.061	68 (57.6)	42 (55.2)	0.18	0.768
8	Can Triclosan be transferred from mother to child	65 (43.6)	16 (34.7)	1.13	0.309	61 (51.6)	20 (26.3)	12.69	0.0001*
9	Can Triclosan influence the birth weight of babies	88 (59.0)	15 (32.6)	9.87	0.002*	68 (57.6)	35 (46)	2.77	0.102
10	Can Triclosan be allergic to human body	102 (68.4)	31 (67.3)	0.02	1.000	93 (78.8)	40 (52.6)	15.51	0.0001*
11	Has triclonan been banned as over the counter drug around the world	99 (66.4)	30 (65.2)	0.02	0.878	79 (66.9)	50 (65.7)	0.08	0.877
12	Has FDA banned the Triclosan in recent time	85 (57)	18 (39.1)	4.53	0.042*	85 (72)	18 (23.6)	44.27	0.0001*
13	Any Ban being imposed on Triclosan in India	75 (50.3)	13 (28.2)	6.92	0.011*	88 (74.5)	0	104.7	0.0001*
14	Is toothpaste available without Triclosan	122 (81.8)	37 (80.4)	0.05	0.830	101 (85.5)	58 (76.3)	3.26	0.089

**p-value significant at <0.05 level*

Table 3. Knowledge scores of dentists in relation to gender and experience

		Knowledge rating			Chi-square value	p-value
		Good N(%)	Fair N(%)	Poor N(%)		
Gender	Male	63 (42.2)	60 (40.2)	26 (17.4)	9.432	0.009*
	Female	8 (17.3)	26 (56.6)	12 (26.0)		
Experience	≤10years	60 (50.8)	47 (39.8)	11 (9.3)	34.189	0.0001*
	>10 years	11 (23.9)	39 (51.3)	27 (35.5)		

**p-value significant at <0.05 level*

Table 4. Eta correlation between knowledge score and experience of the dentists and point biserial correlation between gender and the knowledge scores of the dentists

Eta Correlation		
Correlation	**Eta Value**	**Eta Square**
Experience and Knowledge scores	0.65	0.42
Point Biserial Correlation		
Gender and Knowledge scores	-0.263	0.0001*

**p-value significant at <0.05 level*

4. DISCUSSION

Consumer hygiene products containing triclosan are widely sold as “antibacterial”, however, it also possesses some antiviral and antifungal [14]. At low concentrations, it is bacteriostatic, and at high concentrations, it is bactericidal [15]. Since triclosan is extensively used in consumer products and due to its ease of availability over the counter, there have been concerns about its ill effects on health and nature. To add to this concern, reports are suggesting that resistance developing to triclosan may lead to cross-resistance with other antimicrobials.

Despite being one of the most commonly used agents in everyday products, its utility is under the microscope [16]. The antibacterial activity has been demonstrated to be inadequate when triclosan was incorporated into polymers or soaps compared to non-triclosan-containing controls, which questions its significance in public health [14,17].

Another reason of concern is the exponential increase in the usage/ demand of the product. In the 1970s and 80s, it was mainly used as an antiseptic agent in surgical scrubs. Slowly, its use was extended to soaps, mouthwashes, shower gels, shaving gels, household detergents, kitchen utensils, toothpaste, plastic products, and even clothing [14].

The present study evaluated the level of awareness and perception of dentists towards triclosan, as it is prescribed extensively by them. The lack of sufficient published literature established a firm need to survey to understand and create awareness among dentists regarding its effects on overall health. This study showed that dentists are aware of other products containing triclosan, in addition to mouthwash. The influence of triclosan on body weight was correctly identified by 38.9% of dentists with ≤10years of experience. Studies conducted by Velez et al and Lankester J et al, and the results of the Second Korean National Environmental Health Survey reported by Na-Young Ha also showed that higher levels of triclosan were detected among overweight and obese participants as compared to under-weight and normal-weight participants [18-20].

Feng reported that triclosan reduced levels of the progesterone, estradiol, and testosterone hormones in rat serum after oral lavage [21]. Studies conducted by Paul et al and Louis et al. showed that oral administration of triclosan lowered thyroxine (T4) hormone levels in puppies and rats respectively [22,23]. These studies had to be incorporated due to the limited human trials available on this topic. The study conducted by Na-Young Ha [20] also found a suggestive association between triclosan exposure and serum TSH levels in humans. The present study found that 64.4% of dentists with **≤**10 years of experience agreed that triclosan affects thyroid function.

A study conducted by Pycke BF et al in New York detected the presence of triclosan in 100% of blood samples of expecting mothers and 51% of samples of cord blood taken from the neonates [24]. These results indicate that triclosan is readily absorbed into the body. Triclosan appeared in breast milk, urine, and plasma. The blood levels correlated with the usage of the product by the consumer [25]. In the present study, when asked if triclosan gets transferred from mother to child, only 34.7% of female dentists responded positively.

Several human studies have presented associations between triclosan exposure and respiratory symptoms like asthma, suggesting possible allergic reactions [26-28]. A longitudinal study conducted by Lee-Sarwar K et al. [29], found that increased maternal plasma triclosan concentrations were associated with increased odds of asthma or wheezing in male children. Higher urinary triclosan concentrations were found to be associated with increased allergies among people under 18 years of age in a study conducted by Clayton et al. [26]. Spanier reported higher levels of urinary triclosan may increase the risk of asthma, allergies, and food sensitivity [28]. In addition, Hong suggested that overuse of antimicrobial products was found to be associated with wheezing and allergic rhinitis [27]. More than sixty percent of dentists (both males and females) in the present survey have also reported that triclosan can cause allergies in humans.

A meta-analysis conducted by Riley P and Lamont T assessed the long-term effects of triclosan-containing fluoride toothpaste and compared them with regular fluoride toothpaste, for caries, plaque, and gingivitis control in children and adults [30]. They found that triclosan-containing toothpaste reduced plaque and gingivitis. However, the evidence was of moderate quality, which may or may not be clinically significant. There was weak evidence

that triclosan-containing toothpastes reduce coronal caries. More than 80% of dentists (both male and female) in the current study were aware of triclosan-free toothpaste available in the market. An editorial published in 2017 by Diana Macrii emphasized the need to weigh the benefit to each patient with the help of current scientific evidence, before prescribing triclosan-containing products [31].

5. CONCLUSION

Triclosan is extensively used in various cosmetics, oral care, and deodorant formulations. New concerns regarding the safety of this product in comparison to triclosan-free alternatives are rising rapidly. The present study found that although dentists knew about triclosan, their knowledge regarding its safety was limited. There was mixed opinion regarding banning triclosan in the country. Considering the limited literature on the subject, this study serves as the first step to assess the awareness of the dental community towards triclosan.

6. LIMITATIONS

Despite the scope of this study, it had several limitations. Since a convenience method was used for sampling, the present sample of participants is not representative, which provides only partial generalizability. It only assessed the knowledge of the dentists regarding triclosan and its effects on health. The prescribing behavior was not assessed. The need of the hour is to conduct CDE programs to raise awareness regarding the possible harmful effects of triclosan. Further studies assessing the safety of triclosan in oral products are recommended, which can help with the preparation of a strong scientific evidence base.

CONSENT

As per international standard or university standard, participants' written consent has been collected and preserved by the author(s).

ETHICAL APPROVAL

The study received formal review and approval from the Institutional Ethical Committee before starting the study.

COMPETING INTERESTS

Authors have declared that no competing interests exist.

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