Clinical and Experimental Health Sciences

The Evaluation of Knowledge and Behavior of Medical Doctors about Toothbrush Disinfection

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ABSTRACT

Objective: The behavior and knowledge of medical doctors about toothbrush disinfection was evaluated in this study.

Methods: In this study 170 medical doctors (63 females, 107 males) were included. Participants filled out the standard questionnaires which contained 18 questions into three parts: demographic data, personal oral hygiene practices-patient recommendations about toothbrush disinfection, and toothbrush disinfection. chi-squared and Fisher's exact tests were used for data analyses, where appropriate.

Results: Regarding personal oral hygiene practices; most medical doctors reported toothbrushing at least twice a day and changed their toothbrushes once every three months. The answers of males and females for these questions were significantly different ($p < 0.05$). Most participants used the same toothpaste and stored their toothbrushes in an open-topped toothbrush holder shared with other individuals. The doctors mostly did not any advice their patients about toothbrush usage.

Conclusion: Regarding toothbrush disinfection; most medical doctors did not disinfect their own toothbrushes and reported a lack of knowledge about toothbrush disinfection. On the other hand, the participants mostly thought that disinfection of toothbrush was necessary for every individual. The results of this study showed that majority of the participants were unaware about the subject.

Keywords: Toothbrushing, Disinfection, Medical Doctors

1. INTRODUCTION

Toothbrushes are the most important oral hygiene tool for good oral health and are manufactured as free of microorganisms. After a single use, toothbrushes may become heavily contaminated with several microorganisms in the oral cavity, aerosol contamination, hands, environment and storage conditions (1). Many microorganisms which can remain their viability on toothbrush bristles for periods ranging from a day to a week are found after toothbrushing (2,3). In many systemic and oral diseases (e.g septicemia and gastrointestinal, renal problems, respiratory, cardiovascular), contaminated toothbrushes may play important roles (1).

Although Cobb reported that toothbrush is a cause of repeated infections in the oral cavity as early as 1920, toothbrush disinfection is become attract attention by various authors in last decades (4). Previous studies reported that toothbrush disinfection is required for high-risk patients including children, elders, susceptible populations (*e.g.*, critically ill adults) in a hospital setting and chemotherapy or undergoing organ transplantation or immunosuppressed (1,5). Toothbrushes can serve as reservoir for healthy individuals with poor oral health as well as high-risked patients due to toothbrushes frequently stored in the bathroom or close to the toilet and sink and may be exposed to enteric bacteria dispersed by aerosols (5,6).

Toothbrush contamination much more increases depending on careless usage like sharing toothbrush and improper storage circumstances, and causes the reintroduction of potential pathogens (7). Therefore, proper care of toothbrush is one of the most important issue for good oral health, besides of oral hygiene procedures. Recently, modern dentistry strongly emphasizes storing conditions and disinfection of toothbrushes and changing of toothbrushes at regular intervals, as preventive precautions Various authors agree that toothbrush disinfection is a fundamental component of oral hygiene now. Many studies have suggested different methods for toothbrush disinfection including mouth rinses or immersion/spray in different disinfectant solutions, and bristles impregnated with antimicrobial agents, ultraviolet sanitizer, dishwasher, microwave irradiation etc. (1,7,9-14).

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Patient motivation, education of oral hygiene and preventive procedures are substantially dentist's task (15). In the same way, good oral health behavior and adequate knowledge of the other professionals play an important role for oral health motivation and education of their patients, families, friends and the community (16,17). Because regular dental visit of the individuals and the ratio of dental professional to population were very low in developing countries, oral health motivation and education may be needed to give by medical doctors (18). Additionally, physicians refer to dentists their patients when required, due to oral health and oral care practices may be a predisposing factor for several systemic diseases. In this context, it is essential that physicians are sufficiently informed about oral and dental care such as toothbrush disinfection.

To the best of our knowledge, there is no study investigating the knowledge and behavior of medical doctors about toothbrush disinfection besides of our previous study conducted by dentists. The aim of this study was to evaluate these aspects among medical doctors working at a medical faculty in Turkey. We hypothesized that medical doctors have insufficient knowledge about toothbrush disinfection and they did not regularly carry out any disinfection for their own toothbrush. Our null hypothesis was that knowledge and behavior of medical doctors regarding toothbrush disinfection would be well enough.

2. METHODS

Before starting the study, Approval of Gazi University Ethics Board of the Institutional Ethics Committee was obtained (Date: 25.02.2016 No: E.27143) This study was carried out between June 2016-2017 among medical doctors of Gazi University Faculty of Medicine in Ankara, Turkey.

Written informed consent was given to all participants before enrollment in the study. The standard questionnaires used in our previous study (16) were modified and distributed to medical doctors (Table 1). Table 1 contains three parts in 18 questions 1) 6 questions for demographic data, 2) 7 questions for toothbrush/toothpaste use and recommendations, 3) 5 questions for toothbrush disinfection. The participants (male/female) filled out the questionnaires. The sample size was calculated using G*Power 3.0 software. The calculations were based on effect size =0.3, a 2-tailed test, an α level of .05, and a desired power (β) of 95%. The estimated desired sample size was calculated to be at least 172 participants. However, six forms from 176 questionnaires were excluded from the study due to deficiently filled out in conclusion and 170 questionnaires were evaluated. Therefore, actual power was 0.948.

The questionnaire was given to participants and they filled the forms in person. Six forms from 176 questionnaires were excluded from the study due to deficiently filled out in conclusion and 170 questionnaires were evaluated.

Descriptive statistics, Fisher's exact tests and chi-squared tests (SPSS-15.0, SPSS Inc., Chicago, USA) was used for statistical evaluation, as appropriate. Cramer v correlation coefficients were used to show the power of the correlation. The level of significance was 0.05.

3. RESULTS

Totally 170 medical doctors (63 females, 37.1% and 107 males, 62.9%) age ranged between 30 and 67 years (mean age ± standard deviation: 48±9.4 years) were participated in this study. The results of statistical analyses were shown in Table 2.

Regarding demographics; differences between females and males for age were not significant ($p>0.05$) and most doctors were aged between 41 and 50 years. Most participants were professor, had graduated from medical school over than 11 years ago, with the largest frequency of them graduating from Turkish universities and differences between females and males were not significant ($p>0.05$). Specialists of internal medicine sciences were more common in females than in males, with significantly differed ($p<0.05$).

Regarding personal toothbrush/toothpaste habits and patient recommendations; most doctors brushed their teeth at least twice a day and changed their toothbrushes once every three months. Differences between females and males for these questions ($p<0.05$) were significant. Most participants stored their toothbrushes in open contact with the environment, an open-topped toothbrush holder shared with other family members, thought that contact between toothbrushes was important, and shared their toothpaste with others. The doctors mostly did not any advice their patients about toothbrush usage. There were no statistically significant differences ($p>0.05$) between females and males for the questions (questions no:9-13).

Regarding toothbrush disinfection; most medical doctors reported a lack of knowledge about toothbrush disinfection and did not disinfect their own toothbrushes and no advice gave their patients in this issue. On the other hand, the participants mostly thought that toothbrush disinfection was necessary for everyone. No statistically significant differences ($p>0.05$) were found between females and males for these questions. Details of these results are given in Table 2.

Regarding specialties of the participants and their knowledge and behavior about toothbrush habits and patient recommendations; statistically significant difference ($p<0.05$) was found between specialties of the participants and opinion about the importance of toothbrushes contact'. The more specialists of internal medicine sciences thought that the contact between toothbrushes was important than the specialists of surgical medicine sciences. Also, knowledge of toothbrush disinfection and advice to their patients were more common in the specialists of internal medicine sciences than the others, with statistically significant differed ($p<0.05$). Although the majority of both specialists in two groups indicated that they did not disinfect their own toothbrushes, they were in agreement about the requirement of toothbrush disinfection for everyone, with no statistically significant differed ($p>0.05$). Details of these results are given in Table 3.

Table 1. *Questionnaire used in the study*

Demographics
1. Age
2. Biological sex
3. When did you graduate from the medical school? a) 0–10 years ago b) 11+ years ago
4. What medical school did you graduate from? a) University in Turkey b) University in another country
5. What is your specialty? a) Surgical medicine sciences b) Internal medicine sciences
6. What is your title? a) Specialist and/or Assistant Professor b) Associate Professor c) Professor
Personal toothbrush/toothpaste habits and patient recommendations
7. How often do you brush your teeth? a) Sometimes b) Once a day c) Twice or more a day
8. How often do you change your toothbrush? a) Once in a month b) Bimonthly c) Once every 3 months d) After 3 months or more
9. Where do you store your toothbrush? a) In the bathroom, in open contact with the environment b) In the bathroom, in a closed cabinet
10. How do you store your toothbrush? a) In an open-topped toothbrush holder shared with other family members b) In an closed-topped toothbrush holder shared with other family members c) Separately from the toothbrushes of other family members
11. In your opinion, is the contact between toothbrushes an important issue? a) No b) Yes
12. Do you share your toothpaste with other individuals? a) Yes b) No
13. Do you advise your patients regarding how often they should change their toothbrushes and/or where and how their toothbrushes should be stored? a) I only make suggestions about the frequency of changing their toothbrushes. b) Yes c) No
Toothbrush disinfection
14. Do you have any knowledge about toothbrush cleaning and disinfection? a) No b) Yes
15. Do you disinfect your own toothbrush? a) No b) Yes
16. Do you advise to your patients regarding toothbrush disinfection? a) No b)Yes
17. In your opinion, is toothbrush disinfection necessary? a) No b)Yes
18. If your answer to question 17 is yes, then for whom is toothbrush disinfection necessary? a) Everybody b) Special patient groups, such as immunosuppressed individuals, hospitalized patients, and children c) I have no idea

Table 2. *Descriptive statistical analysis of the questionnaire, per biological sex.*

Questions		Female N (%)	Male N (%)	p value	r
Demographics					
1. Age	a) 30-40 years b) 41-50 years c) 51 + years	15(23.8) 25 (39.7) 23 (36.5)	19 (17.8) 48 (44.9) 40 (37.3)	0.612	0.055
3. When did you graduate from the medical school?	a) 0–10 years ago b) 11+ years ago	11 (17.5) 52 (82.5)	9 (8.4) 98 (91.6)	0.077	0.120
4. What medical school did you graduate from?	a) University in Turkey b) University in another country	62 (98.4) 1 (1.6)	104 (97.2) 3 (2.8)	0.526[a]	0.043
5. What is your specialty?	a) Surgical medicine sciences b) Internal medicine sciences	22 (34.9) 41 (65.1)	59 (55.1) 48 (44.9)	0.011*	0.257*
6. What is your title?	a) Specialist or assistant professor b) Associate Professor c) Professor	11 (17.5) 19 (30.1) 3 (52.4)	15 (14.0) 26 (24.3) 66 (61.7)	0.494	0.077
Personal toothbrush/toothpaste habits and patient recommendations					
7. How often do you brush your teeth?	a) Sometimes b) Once a day c) Twice or more a day	1 (1.6) 13 (20.6) 49 (77.8)	7 (6.5) 37 (34.6) 63 (58.9)	0.033*	0.216*
8. How often do you change your toothbrush?	a) Once in a month b) Bimonthly c) Once every 3 months d) After 3 months or more	8 (12.7) 21 (33.3) 26 (41.3) 8 (12.7)	11 (10.3) 19 (17.8) 38 (35.5) 39 (36.4)	0.005*	0.293*
9. Where do you store your toothbrush?	a) In the bathroom, in open contact with the environment b) In the bathroom, in a closed cabinet	52 (82.5) 11 (17.5)	86 (80.4) 21 (19.6)	0.727	0.041
10. How do you store your toothbrush?	a) In an open-topped toothbrush holder shared with other family members b) In a closed-topped toothbrush holder shared with other family members c) Separately from the toothbrushes of other family members	31 (49.2) 4 (6.3) 28 (44.5)	60 (56.1) 8 (7.5) 39 (36.4)	0.587	0.082
11. In your opinion, is the contact between toothbrushes an important issue?	a) No b) Yes	6 (9.5) 57 (90.5)	16 (15.0) 91 (85.0)	0.308	0.088
12. Do you share your toothpaste with other individuals?	a) Yes b) No	35 (55.6) 28 (44.4)	72 (67.3) 35 (32.7)	0.126	0.147
13. Do you advise your patients regarding how often they should change their toothbrushes and/or where and how their toothbrushes should be stored?	a) I only make suggestions about the frequency of changing their toothbrushes. b) Yes c) No	9 (14.3) 4 (6.3) 50 (79.4)	15 (14.0) 7 (6.5) 85 (79.5)	0.998	0.016
Toothbrush disinfection					
14. Do you have any knowledge about toothbrush cleaning and disinfection?	a) No b) Yes	49 (77.8) 14 (22.2)	79 (73.8) 28 (26.2)	0.565	0.004
15. Do you disinfect your own toothbrush?	a) No b) Yes	49 (77.8) 14 (22.2)	85 (79.4) 22 (20.6)	0.798	0.020
16. Do you advise to your patients regarding toothbrush disinfection?	a) No b) Yes	52 (82.5) 11 (17.5)	90 (84.1) 17 (15.9)	0.790	0.024
17. In your opinion, is toothbrush disinfection necessary?	a) No b) Yes	9 (14.3) 54 (85.7)	25 (23.4) 82 (76.6)	0.153	0.025
18. If your answer to question 17 is yes, then for whom is toothbrush disinfection necessary?	a) Everybody b) Special patient groups, such as immunosuppressed individuals, hospitalized patients and children c) I have no idea	48 (76.2) 7 (11.1) 8 (12.7)	73 (68.2) 8 (7.5) 26 (24.3)	0.164	0.160

*Statistical analysis result according to Fisher exact test. r: Cramer V correlation coefficient, * p<0.05*

Table 3. *The comparison between specialties of the participants and their knowledge and behavior about toothbrush habits and patient recommendations*

Questions		Specialists of surgical medicine sciences	Specialists of internal medicine sciences	p value	r
		N (%)	N (%)		
11. In your opinion, is the contact between toothbrushes an important issue?	a) No b) Yes	15 (18.5) 66 (81.5)	7 (7.9) 82 (92.1)	0.039*	0.159*
14. Do you have any knowledge about toothbrush cleaning and disinfection?	a) No b) Yes	67 (82.7) 14 (17.3)	61 (68.5) 28 (31.5)	0.032*	0.164*
15. Do you disinfect your own toothbrush?	a) No b) Yes	67 (82.7) 14 (17.3)	67 (75.3) 22 (24.7)	0.236	0.091
16. Do you advise to your patients regarding toothbrush disinfection?	a) No b)Yes	73 (90.1) 8 (9.9)	69 (77.5) 20 (22.5)	0.027*	0.170*
17. In your opinion, is toothbrush disinfection necessary?	a) No b)Yes	20 (24.7) 61 (75.3)	14 (15.7) 75 (84.3)	0.145	0.112
18. If your answer to question 17 is yes, then for whom is toothbrush disinfection necessary?	a) Everybody b) Special patient groups, such as immunosuppressed individuals, hospitalized patients, and children c) I have no idea	55 (67.9) 5 (6.2) 21 (25.9)	66 (74.2) 10 (11.2) 13 (14.6)	0.124	0.157

** p<0.05 r: Cramer V correlation coefficient*

4. DISCUSSION

Knowledge and behavior of medical doctors were evaluated regarding oral care and toothbrush disinfection in the present study. Most participants (approximately 75%) were unaware about toothbrush disinfection and did not have disinfect their own toothbrush (approximately 79%). This result confirmed our hypothesis. However, 71% of the participants thought that toothbrush disinfection was necessary for all individuals. These results were in accordance with our previous published study conducted with dentists (16). Toothbrush disinfection has become an issue that needs to be emphasized more especially today, when the covid-19 pandemic has spread all over the world. It is important that all healthcare professionals have knowledge about the subject.

Toothbrushing at least twice a day has been suggested by American Dental Association (ADA) for good oral health (19). In this study, most participants (approximately 66%) brushed their teeth twice or more a day. The frequency of toothbrushing habit and changing the toothbrush were higher in females than in males, with statistically significant difference. Various studies have investigated oral health behavior and attitudes for different study samples such as health care professionals, university students, dentists and dental students, etc. Baseer et al reported that only 3.9% of the health professionals including doctors, medical students, technicians, pharmacists and nursing staff brushed their teeth twice a day (17). Sharda and Sheety reported that 47.8% of the participants including non-medical, para-medical and medical students brushed their teeth twice a day (20). The rate of toothbrushing twice a day has been reported as relatively higher in dentists and dental students (55% to 87%) (15,16,21-23). Females generally pays more attention to their own personal care and appearance in comparison with males. Many studies have been confirmed that oral health behavior of females was better than males (15-17,23). The results of the present study were in accordance with previous reports.

Storage conditions play an important role for toothbrush contamination. Because moist environment allows to increase bacterial survival, it was suggested that toothbrushes should be stored as open-topped instead of closed containers (7,24). Also, toothbrushes should be stored in an upright position and provided to air-dry until reused. The contact among toothbrushes may occurred when stored with others individuals' or in the same toothbrush box, should be kept separately (19). Additionally, ADA suggested that toothbrushes should be replaced every 3 months due to the loss of mechanical effect, not bacterial contamination (19). However, the current study compared to difference of bacterial contamination between toothbrushes used for 3 months and 1-month, also compared to storage conditions they kept with family members and separately (25). The results showed that the toothbrushes used for 3 months and kept with family members had become heavily contaminated than the others. Thus, the authors suggested that toothbrush should be changed after every 3-4 weeks and stored in upright position and separately to avoid cross-contamination (25). The risk of cross-contamination

increases when toothpastes shared with other individuals (7,26). Sharing toothpaste among family members may be high-risk factor related with transmission of hepatitis C virus infection (27). It was reported that dentists generally stored their own toothbrushes in a toothbrush box, and shared the toothpaste with other individuals, and changed theirs every 3 to 4 months (16). In this study, the storage conditions and replacement period of toothbrushes were found to be very similar with our previous study (16).

ADA currently published some recommendations for toothbrush care. Although bacterial contamination of toothbrushes is discussed, there is no tangible evidence related with toothbrush cleaning methods are effective for oral and general health. However, common-sense approaches were suggested for immunosuppressed individuals and high-risk patients with transmissible systemic diseases by blood or saliva. These procedures include replacing toothbrushes more often than 3-4 months, rinsing with the antibacterial mouth rinses before brushing, disposable toothbrushes, but it may be high cost and use of toothbrush sanitizers cleared by Food and Drug Administration (19).

Knowledge about toothbrush disinfection was found more common in specialists of internal medicine sciences than specialists of surgical medicine sciences and the difference was statistically significant. Similarly, the specialists of internal medicine sciences mostly thought that contact between toothbrushes was an important issue and advised to their patients for toothbrush disinfection, statistically significant different from the surgeons. Dentists generally receive various lectures during their undergraduate training about the relationship between oral health and systemic diseases (22,28). However, previous studies showed that medical students receive a few hours' lecture regarding oral health during all training years (29,30). It was reported that knowledge and awareness of medical students and physicians about periodontal diseases, caries, the relationship between oral diseases and systemic conditions were deficient (17,18,30,31). The investigators agree that medical education should be included oral health and dental topics in the curriculum of medical education (17,18,31,32). It was also concluded that severity of the COVID-19 could be potentially impacted by the invidual's oral health status. In addition, an increase in CRP values was correlated with poor oral health. This also portrays a serious condition of the disease. Recovery periods were also observed to be longer for poor oral health patients. For predicting the severity of COVID-19, the cut-off value coming from the oral health scoring used in this questionnaire could be used on a larger scale. For dental practitioners it is also possible to use this type of questionnaire before the clinical examination in order to reduce the exposure time (33).

A limitation of this study was that the specialties of the medical doctors included in the study were not selected in the branches directly related to the risk of infection and inflammation. In further studies, the knowledge and behaviors of healthcare professionals working in intensive care units, infectious diseases clinics, transplantation units and oncology clinics etc. where the risk of infection is high, about toothbrush disinfection can be investigated.

5. CONCLUSIONS

In conclusion, behavior and knowledge of medical doctors about toothbrush disinfection first time investigated to date in this study. The results showed that majority of the participants were unaware regarding the subject and did not have disinfect their own toothbrush and thought that toothbrush disinfection was necessary for all individuals. Even though motivation and education of the patients about oral health practices are dentist's task, medical doctors should be aware oral care such as toothbrush disinfection. In these challenging times of Covid-19 pandemic, the training of medical doctors on the disinfection and storage conditions of toothbrushes has become very important.

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