Research Article

Knowledge, Attitude, and Barriers to Fluoride Application as a Preventive Measure among Oral Health Care Providers

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Objective. To investigate the knowledge, attitude, and possible barriers to fluoride application among oral health-care providers in Kuwait. Methods. A validated self-administered questionnaire was distributed to a random sample of 291 dentists. The questionnaire included four categories: dentists’ characteristics, knowledge of and attitude towards fluoride application, factors influencing decision-making on prescription of fluoride, and the clinician’s perception of own knowledge. Means, group differences, and logistic regression were calculated. Results. 262 completed the questionnaire (response rate of 90%). Half of the participants (49%) reported that water fluoridation is the best method for caries prevention in children. Majority of the participants (80%) acknowledged that topical fluoride prevents dental caries, but only 40% frequently use it in their practices. Fear of overdose was a concern in 57% of the participants. About 31% believed that caries is a multifactorial disease and cannot be prevented. In addition, 32% of the dentists who thought caries is multifactorial and cannot be prevented stated that restorations take precedence over preventive therapy. Conclusion. Despite the participants being in favor of topical fluoride application and believing in its effectiveness, certain barriers were apparent such as knowledge deficiencies, products labelling flaw, and lack of participation in effective continuing educational activities.

1. Introduction

A major decline in the prevalence of dental caries has been observed over recent decades. This decline has been attributed to the widespread use of daily fluoride toothpaste [1]. Kuwait is considered a nonfluoridated community since water fluoridation was discontinued in 1980 [2]. In addition, salt, milk, and juice are not fluoridated, and individuals have access to both fluoridated and nonfluoridated toothpaste. Despite the preventative effort from the Ministry of Health and the School Oral Health programs, caries is still considered a major problem [2, 3]. Al-Mutawa et al. [3] found that only 24–32% of 4- and 5-year-old children were caries-free, and the decayed score of the dft/dfs was the major component of the mean scores. Similar scores were reported for DFT/DFS in 12- and 14-year-olds [4].

The sizable amount of available dental literatures in addition to frequent controversies among clinicians and researchers has made decision-making for dental care and treatment planning very complex [5, 6]. Decision-making on caries diagnosis and management is primarily based on factors related to the dentist’s characteristics, knowledge and experience, and to patient and practice factors [5, 7]. Dentists’ knowledge and attitudes toward evidence-based clinical practices are very important to the profession to be able to offer the best possible care to the patient and to effectively influence their oral health behavior [8–10].

The American Dental Association (ADA) and the National Institute of Health and Care Excellence (NICE) place emphasis on the prevention and early detection of dental caries as the most important elements in any health-care program [11, 12]. With the current level of evidence, fluoride is well documented.
as an effective preventative method against dental caries for people at risk of developing dental caries via enhancing remineralization and inhibiting demineralization [13–19]. The application of this knowledge in clinical practice seems deficient and not well adopted [9, 10, 20, 21]. Bansal et al., reported that dentists showed a lack of understanding of fluorides’ main mechanism of action which could lead to inappropriate judgement on the effectiveness of its use in different age groups [20]. Another study demonstrated a positive attitude towards preventative dental care but a deficiency in the knowledge regarding the role of fluoride in caries prevention as well as underestimation of fluoridated toothpaste role in caries control and reduction [9]. Investigators concluded that many dentists are not prepared well neither to prescribe the right fluoride regimen nor to council patients/parents about the appropriate fluoride use [22]. The aim of this study was to assess the knowledge, attitude, and possible barriers to fluoride application among dentists in Kuwait.

2. Material and Methods

Ethical approval was granted from the Health Science Center Ethical Committee, Kuwait University, and the Ethics and Research Committee, Kuwait Ministry of Health. All participants provided a signed informed consent. The study was conducted in full accordance with ethical principles, including the Declaration of Helsinki. A questionnaire was designed to investigate knowledge and attitudes as well as barriers to fluoride use as a preventative measure among dentists in Kuwait. The questionnaire was developed according to previous surveys, ADA guidelines, and the most recent available evidence [9, 14, 16, 17, 21]. A pilot study was performed on ten dentists (later excluded from the final sample) working at the Faculty of Dentistry, Kuwait University. This was done to assure that the survey questions were well formulated relating to the objectives of the study and that questions are well understood by the targeted dentists. Face validity was measured against a construct definition. Twenty-four items received 10 out of 10, and five items received 6 out of 10 and were removed mainly because the dentists thought they were unrelated to the objectives of the study. The validated survey was then readministered to the same 10 dentists, and all 24 questions were correctly answered by all participants.

The questionnaire was divided into 4 sections and consisted of 24 questions. In the first section, the dentists reported on their demographics, dental training, and practice after graduation. The second and third sections investigated the dentists’ knowledge and attitude towards fluoride and its application. The last section examined the dentists’ perception of their own knowledge regarding fluoride applications and the best methods for obtaining new evidence-based information.

The final sample size was calculated based on a confidence level of 90% and marginal error of 5%. At the time of carrying out this study, there were 1160 registered general dentists and specialists working in Kuwait (as per the latest manpower statistics of the Kuwait Ministry of Health) [23]. Therefore, the required sample size was estimated at 219 participants. To account for a possible 25% drop out/refusal, 291 dentists were met in person and invited to participate in this study. The study population was randomly selected by a multistage random-sampling method.

A total of 291 dentists working in the six health districts of the country from primary care clinics, specialty care clinics, and the private sector were invited to participate and complete the self-administered questionnaire.

Data were coded, verified, and analyzed using SPSS (version 18; SPSS Inc., Chicago, IL, USA). The logistic regression and chi-square tests were used for the analysis. A probability level of less than 0.05 was considered as statistically significant.

3. Results

A total of 291 dentists were invited to participate, and 262 (176 males and 86 females) completed the questionnaire, giving a response rate of 90%. Table 1 summarizes the participants’ characteristics, in which specialty was further divided into three groups: general dental practitioner, specialist caring for children (including pediatric dentists, orthodontists, and dental public health), and a third group of other specialties.

The participants’ perception of the most effective methods for caries prevention in children and adults is shown in Table 2. Almost half of the participants (49%) stated that the most effective methods for caries prevention were water fluoridation for children and fluoridated toothpaste for adults. In addition, a few of the dentists believed that caries

| Characteristics | n (%) |
|-----------------|-------|
| Sex             |       |
| Male            | 179 (67) |
| Female          | 86 (33) |
| Age             |       |
| ≤30 years       | 107 (43) |
| 31–45           | 114 (46) |
| ≥46             | 27 (11) |
| Nationality     |       |
| Kuwaiti         | 147 (57) |
| Non-Kuwaiti     | 111 (43) |
| Region of undergraduate dental education |       |
| North America   | 38 (16) |
| Europe          | 40 (16) |
| Asia            | 59 (24) |
| Middle East     | 109 (44) |
| Year of practice|       |
| ≥10             | 155 (61) |
| <10             | 101 (39) |
| Specialty       |       |
| General dental practitioners | 147 (57) |
| Specialist (PD, ORTHO, and DPH) | 39 (15) |
| Other specialists | 71 (28) |
| Work place      |       |
| Primary care clinics | 97 (38) |
| Specialty care clinics | 120 (46) |
| Private clinics | 42 (16) |
| Area of practice|       |
| Rural           | 113 (44) |
| Urban           | 142 (56) |
and adults, the responses varied. Surprisingly, 49% stated that for children, water fluoridation is the most effective method; whereas for adults, 49% reported fluoridated toothpaste as being the most effective. Only 11% thought that fluoridated toothpaste is more effective for children compared to other application forms. This suggests that for children, dentists believe that the main effect of fluoride is primarily during the preeruptive stage. Similar findings were also reported in a previous study, where only 5% of participants identified that the posteruptive effect of fluoride surpasses any preeruptive effects [20]. Yoder et al. [21] also found that the majority of dental professionals were unaware of the fluoride’s predominant posteruptive mode of action. Understanding the mechanism of action of any therapeutic agent—in this case fluoride—is critical since it will help in providing the best preventive programs for the patient, which will eventually maximize disease control [13, 20, 21]. In addition, believing that water fluoridation is the most effective method of caries prevention in children may affect parents counseling and education of tooth brushing methods and frequency by causing them to underestimate the importance of these methods [20, 21, 24].

In the logistic regression model, dentists who graduated from a Northern American undergraduate dental program were in favor of water fluoridation as the most effective fluoride regimen to prevent dental caries in children. One explanation could be that undergraduate curricula from different universities were suggested to have an influence on dentists’ knowledge as reported by different studies [25, 26]. Some authors found that most dentists depend on knowledge gained from their undergraduate studies as the main source of information for their daily practice [26]. Different clinical guidelines and protocols as well as clinical training can also contribute to such beliefs [25, 26]. It is also possible that some participants confused the terms “cost-effectiveness” and “most effective”, which might have affected their choice.

Most of the dentists in this study (80%) reported that topically applied fluoride has a beneficial effect in caries prevention for both children and adults. Almost 95% stated that professionally applied topical fluoride in the form of varnishes, gels, and foams makes enamel more caries resistant. Still, only 36% believed that it is more beneficial than systemic fluoridation, which clearly shows the confusion in fluoride’s predominant mode of action. Even though 91% of participants believed that it is safe in recommended concentrations and application protocols, 57% still have fear of overdose. This developed fear may be due to that studies and trials rarely provide information on toxicity and adverse effects [14, 20].

When it comes to clinical application, 65% of the participants reported that topical fluoride in gel form was their preferable method of choice. However, 65% of those were unfortunately unaware of the optimal application time of the gel form and will use it for less than 4 minutes, which may minimize the overall effectiveness and benefits. Even though some of the manufacturers recommend an application time of only 1 minute, this duration of application was not supported by the literature [20]. Some studies suggested that flaws in product-labelling and manufacturer instructions

### Table 2: Participants’ beliefs regarding the most effective fluoride regimen to prevent dental caries in children and adults.

|                             | Children n (%) | Adult n (%) |
|-----------------------------|----------------|-------------|
| Water fluoridation          | 98 (49)        | 30 (15)     |
| Fluoride toothpaste         | 23 (11)        | 101 (49)    |
| Fluoride rinses             | 1 (1)          | 10 (5)      |
| Professionally applied topical fluoride | 61 (30) | 44 (21) |
| Fluoride supplements (tablets and drops) | 10 (5) | 4 (2) |
| Caries cannot be prevented  | 8 (4)          | 17 (8)      |

4. Discussion

Topical fluoride application in the form of toothpastes, mouth rinses, varnishes, and gels has been shown to prevent dental caries [13, 14, 16, 17]. In this questionnaire, when dentists were asked about the most effective methods of fluoride regimens to prevent dental caries for both children and adults, the responses varied. Surprisingly, 49% stated that for children, water fluoridation is the most effective method; whereas for adults, 49% reported fluoridated toothpaste as being the most effective. Only 11% thought that fluoridated toothpaste is more effective for children compared to other application forms. This suggests that for children, dentists believe that the main effect of fluoride is primarily during the preeruptive stage. Similar findings were also reported in a previous study, where only 5% of participants identified that the posteruptive effect of fluoride surpasses any preeruptive effects [20]. Yoder et al. [21] also found that the majority of dental professionals were unaware of the fluoride’s predominant posteruptive mode of action. Understanding the mechanism of action of any therapeutic agent—in this case fluoride—is critical since it will help in providing the best preventive programs for the patient, which will eventually maximize disease control [13, 20, 21]. In addition, believing that water fluoridation is the most effective method of caries prevention in children may affect parents counseling and education of tooth brushing methods and frequency by causing them to underestimate the importance of these methods [20, 21, 24].

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may play a role in the dentist’s ability to correctly use many of the available fluoride products which will affect their effective use and counseling with patients [21]. In other studies, the matter of labelling confusion was also raised for varnish products. Varnish products are FDA-approved to be used as cavity liners and not as a preventive agent [22]. The recommendation of using varnish to prevent caries is described as “off the label” [22]. This imprecise labelling of

Table 3: Logistic regression model for dentists who believed (dependent variable) that water fluoridation is the most effective fluoride regimen to prevent dental caries in children.

| Variables | Systemic (%) | Topical (%) | Caries cannot be prevented (%) | Odds ratio | CI (95%) | P |
|-----------|--------------|-------------|-------------------------------|------------|----------|---|
| Gender    |              |             |                               |            |          |   |
| Males     | 55.1         | 39.0        | 5.9                           | 0.26       | 0.46–0.98| 0.48|
| Females (reference) | 50.8 | 49.2 | 0.0 | — | — | — |
| Age group (years) |          |             |                               |            |          |   |
| ≤30       | 51.8         | 43.5        | 4.7                           | 0.66       | 1.11–2.43| 0.46|
| 31–45     | 53.8         | 41.8        | 4.4                           | 0.90       | 0.51–2.32| 0.21|
| ≥46 (reference) | 55.6 | 44.4 | 0.0 | — | — | — |
| Region of undergraduate dental education |          |             |                               |            |          |   |
| North America | 71.0 | 29.0 | 0.0 | 1.55 | 2.58–0.52| 0.003|
| Europe    | 63.3         | 33.3        | 3.3                           | 0.90       | 1.88–0.07| 0.07|
| Asia      | 54.5         | 43.2        | 2.3                           | 0.66       | 1.67–0.35| 0.20|
| Middle East (reference) | 44.7 | 48.2 | 7.1 | — | — | — |
| Specialty |              |             |                               |            |          |   |
| General dental practitioner | 50.4 | 44.3 | 5.2 | 0.05 | 1.22–1.12| 0.93|
| Specialists caring for children | 62.1 | 37.9 | 0.0 | 0.53 | 1.54–0.49| 0.31|
| Other specialists (reference) | 55.6 | 40.7 | 3.7 | — | — | — |
| Years of practice |          |             |                               |            |          |   |
| ≥10       | 51.6         | 43.4        | 4.9                           | 0.25       | −0.81–1.31| 0.65|
| <10 (reference) | 58.1 | 39.2 | 2.7 | — | — | — |
| Area of practice |          |             |                               |            |          |   |
| Rural     | 50.0         | 43.9        | 6.1                           | 0.18       | 0.50–0.85| 0.61|
| Urban (reference) | 55.4 | 41.5 | 3.1 | — | — | — |
| Work place |          |             |                               |            |          |   |
| Primary care clinics | 51.2 | 47.5 | 1.2 | 0.25 | 0.91–1.42| 0.67|
| Specialty care clinics | 52.7 | 40.7 | 6.6 | 0.54 | 0.48–1.55| 0.30|
| Private (reference) | 65.5 | 34.5 | 0.0 | — | — | — |
| Topically applied fluoride has no risk of overdosing |          |             |                               |            |          |   |
| Agree     | 54.8         | 38.7        | 6.5                           | 0.50       | 1.81–0.81| 0.45|
| Disagree  | 54.7         | 43.6        | 1.7                           | 0.32       | 1.56–0.93| 0.62|
| Not sure  | 47.4         | 42.1        | 10.5                          | —          | —        | —  |

Table 4: Participants’ beliefs regarding benefits and risks of professional topical fluoride application.

| Can prevent caries | Agree n (%) | Disagree n (%) | Not sure n (%) |
|--------------------|-------------|----------------|---------------|
| 205 (80)           | 27 (10)     | 25 (10)        |
| Has a beneficial effect on children’s oral health | 239 (93) | 6 (2) | 13 (5) |
| Has a beneficial effect on adults’ oral health | 183 (72) | 37 (14) | 36 (14) |
| Makes enamel more caries resistant | 241 (95) | 6 (2) | 8 (3) |
| Is preferable to systemic fluoridation (water, tablets, or drops) | 91 (36) | 109 (43) | 53 (21) |
| Is preferable to brushing twice a day with fluoride toothpaste | 64 (25) | 173 (68) | 17 (7) |
| Decreases the interest in tooth brushing | 31 (12) | 199 (78) | 25 (10) |
| Is safe in recommended concentration and application | 230 (91) | 9 (4) | 14 (5) |
| Has no adverse effects | 82 (32) | 145 (57) | 29 (11) |

Table 5: Reasons for not applying professional topical fluoride application in clinical practice.

| Factors | Agree n (%) | Disagree n (%) | Not sure n (%) |
|---------|-------------|----------------|---------------|
| Restorative treatment should take precedence over prevention | 40 (16) | 186 (78) | 13 (6) |
| Busy in practice, no time for topical fluoride application | 44 (18) | 186 (77) | 13 (5) |
| Caries cannot be prevented since it is a multifactorial disease | 75 (31) | 145 (59) | 24 (10) |
different topical fluoride agents may cause confusions and eventually barriers to its application. In addition, the handling properties of topical fluoride agents can play a role in its application. Participants reported using topical fluoride irregularly in their clinic, in which only 40% frequently apply it to their patients. Since the majority of our participants are using fluoride gel, it could be the handling properties of the gel that hinder their frequent use. As documented in the literature, fluoride gel is very effective as an anticaries agent; however, it has some drawbacks such as the bitter taste, as well as the 4-minute waiting experience with an ill-fitting tray, which can be an unpleasant experience [22].

In this era, with all the advancements in research, knowledge, and dental technologies, it was surprising to see that 31% of our participants did not support topical fluoride application for caries prevention because they believed that caries is a multifactorial disease and cannot be prevented. Dental caries cannot be prevented because caries is a multifactorial disease

| Variables                                      | Agree (%) | Disagree (%) | Not sure (%) | Odds ratio | CI (95%) | P     |
|------------------------------------------------|-----------|--------------|--------------|------------|----------|-------|
| Gender                                         |           |              |              |            |          |       |
| Males                                          | 16.5      | 78.7         | 4.9          | −0.30      | −1.13−0.53 | 0.48  |
| Females (reference)                            | 16.0      | 76.5         | 7.4          | —          | —        | —     |
| Age group (years)                              |           |              |              |            |          |       |
| ≤30                                            | 21.2      | 72.7         | 6.1          | 0.58       | −1.19−2.35 | 0.52  |
| 31–45                                          | 12.0      | 85.2         | 2.8          | 0.05       | −1.36−1.46 | 0.95  |
| ≥46 (reference)                                | 16.7      | 75.0         | 8.3          | —          | —        | —     |
| Region of undergraduate dental education       |           |              |              |            |          |       |
| North America                                  | 11.1      | 88.9         | 0.0          | 0.67       | −0.52−1.86 | 0.27  |
| Europe                                         | 13.9      | 80.6         | 5.6          | 0.85       | −0.32−2.02 | 0.16  |
| Asia                                           | 1.8       | 94.6         | 3.6          | 1.28       | −0.51−2.61 | 0.06  |
| Middle East (reference)                        | 26.0      | 68.3         | 5.8          | —          | —        | —     |
| Specialty                                      |           |              |              |            |          |       |
| General dental practitioners                   | 21.2      | 72.3         | 6.6          | −0.03      | −1.31−1.26 | 0.97  |
| Specialists caring for children                 | 7.7       | 89.7         | 2.6          | 0.21       | −1.01−1.43 | 0.74  |
| Other specialists (reference)                  | 12.3      | 84.6         | 3.1          | —          | —        | —     |
| Years of practice                              |           |              |              |            |          |       |
| ≥10                                            | 20.1      | 74.3         | 5.6          | −0.66      | −1.89−0.57 | 0.29  |
| <10 (reference)                                | 10.4      | 84.4         | 5.2          | —          | —        | —     |
| Area of practice                               |           |              |              |            |          |       |
| Rural                                          | 14.3      | 78.6         | 7.1          | 0.06       | −0.73−0.84 | 0.88  |
| Urban (reference)                              | 17.2      | 77.7         | 5.1          | —          | —        | —     |
| Work place                                     |           |              |              |            |          |       |
| Primary care clinics                           | 19.8      | 74.7         | 5.5          | −0.14      | −1.48−1.22 | 0.85  |
| Specialty care clinics                         | 15.8      | 78.9         | 5.3          | −0.30      | −1.51−0.90 | 0.62  |
| Private (reference)                            | 10.5      | 84.2         | 5.3          | —          | —        | —     |

A logistic regression model showed a significant association between dentists who believed that restorative treatment should take precedence over prevention and those who believed that caries is a multifactorial disease and cannot be prevented. Dental caries is frequently described as a multifactorial disease process [27, 28]. Recent reviews suggested that with broader understanding of the disease’s process, we can consider the dietary sugars to be the main cause of the disease and the other factors as causal factors that speed the disease process [29, 30]. By understanding the disease’s process in its broader definition, we can conclude that treatment of dental caries can be achieved through nonoperative procedures that include dietary and plaque control along with remineralization therapy [31, 32]. In addition, the philosophy of “drill and fill” to treat the disease in early stages could dictate the dentist’s treatment decision-making, and the concept of minimally invasive dentistry is still facing some obstacles to its application by some dentists [8]. Moreover, undergraduate dental education from different universities was found to significantly play a role in the dentists’ belief that caries is a multifactorial disease and...
cannot be prevented, to which few Asian undergraduates agreed. It could be that the Asian curriculum is more affiliated with the European system that has been described for many years to adopt a preventative treatment philosophy [33]. Also, differences in education had an effect on both preventative knowledge and preventative dental behaviors amongst Asians as reported by Soh [34].

Contradiction amongst our participants was evident when the majority (60%) claimed that they had adequate knowledge regarding topical fluorides but still 67% reported that they needed further information. In addition, 63% reported attending topical fluoride continuous education (CE) sessions in the past 5 years or less. Hence, there seems to be some doubts and uncertainties when it comes to the knowledge and use of fluoride.

In our study, 45% of the participants stated that the best method to obtain new information is through special courses, lectures and seminars; 23% through scientific journals; 17% through newsletter; and 15% through the World Wide Web. The literature shows that interactive educational meetings through attending workshops and participation in active discussions with the lecturers is the most effective intervention to diffuse certain knowledge and thus changing clinical practice [35]. However, distribution of passive educational material like guidelines and publications, didactic educational meetings, and lectures have little or no effect on changing practitioners’ knowledge or attitude and eventually cause a change in their routine dental practice [35]. To overcome the deficient knowledge among dentists working in Kuwait, an annual interactive workshop that highlights the importance of dental caries prevention, effective strategies, and available materials is highly needed to influence the change and improve the current dental knowledge, attitude, and practice.

In conclusion, despite the belief in topical fluoride effectiveness, certain barriers were apparent to its application. Knowledge deficiencies and attitude of practitioners play a major role. Clinical uncertainty as a result of labelling flaws, outdated undergraduate education, inappropriate continuous education, and lack of participation in effective educational activities are barriers too, and they can hinder clinicians from practicing evidence-based dentistry in their routine dental practice.

**Conflicts of Interest**

The authors declare that there are no conflicts of interest in this study.
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