Preventive Dentistry and Dental Education in Iran

Mohammad R. Khami

Academic dissertation

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Helsinki 2007
In the name of the Lord life creating,

The wise one speech creating within the tongue,

The Lord, the giver, hand seizing,

Merciful, sin forgiving, excuse accepting.

Sa'adi Shirazi (Iranian poet, 1213-1293 A.D)
Abstract


The present study investigated the preventive orientation of the dental education system in Iran as reflected in the responses of dental school educators and dental students to a questionnaire survey.

Two questionnaires, one for dental school educators and one for senior dental students, were designed and piloted. Of the 15 state dental schools in Iran, 7 were selected using a multi-stage sampling approach, and all the dental school educators and senior dental students in these schools were asked to voluntarily fill in the anonymous questionnaires. Totally, 291 educators (80%) and 270 students (82%) participated in the study.

In addition to background information, both questionnaires requested information on knowledge of caries prevention, attitudes towards preventive dentistry and oral health behaviour of the respondents. The students' questionnaire also covered items concerning prevention-oriented practice, study motives, and career preferences.

Contrary to knowledge and attitudes of the students, those of the educators' were positively associated with some of their academic and personal background characteristics. Women were more likely to report favourable oral self-care habits than men. The other determinants of oral health behaviour were educators' familiarity with the oral public health field, and students' attitudes towards prevention. A higher score on preventive practice among the students was associated with better oral self-care habits and positive attitudes towards prevention. “Characteristics of the profession” and “social status and security” were the top-ranked that motivated students to study dentistry, and students mainly preferred to enter postgraduate courses and private practice after graduation.

To increase the orientation of Iran's health care system towards prevention, and to cope with current concepts of prevention, corresponding changes should be made in the dental education system. The results of this study support the revision of the dental curriculum by placing more emphasis on prevention-related topics and by integrating prevention-related concepts into all disciplines.
Additionally, practicing dentists and dental educators should be provided with opportunities to attend continuing education courses and to conduct seminars and congresses on various aspects of preventive dentistry at home as well as abroad.

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List of publications

This thesis is based on the following articles referred to in the text by their Roman numerals.


**Abbreviations**

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<tr>
<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>ADA</td>
<td>American Dental Association</td>
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<tr>
<td>ADEA</td>
<td>American Dental Education Association</td>
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<td>ADEE</td>
<td>Association for Dental Education in Europe</td>
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<tr>
<td>APF</td>
<td>Acidulated phosphate fluoride</td>
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<tr>
<td>CI</td>
<td>Confidence interval</td>
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<tr>
<td>DDS</td>
<td>Doctor of Dental Science</td>
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<td>DHDS</td>
<td>Dental Health care Delivery System (in Iran)</td>
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<tr>
<td>DMFT</td>
<td>Number of decayed, missing and filled permanent teeth</td>
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<td>dmfT</td>
<td>Number of decayed, missing and filled primary teeth</td>
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<tr>
<td>MOHME</td>
<td>Ministry of Health and Medical Education</td>
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<td>MS</td>
<td>Master of Science</td>
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<td>NaF</td>
<td>Sodium fluoride</td>
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<td>NIH</td>
<td>National Institute of Health</td>
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<td>OHB</td>
<td>Oral health behaviour</td>
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<td>OPH</td>
<td>Oral public health</td>
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<td>OR</td>
<td>Odds ratio</td>
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<td>OSC</td>
<td>Oral self-care</td>
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<td>OSCE</td>
<td>Objective Structured Clinical Examination</td>
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<tr>
<td>PBL</td>
<td>Problem-based learning</td>
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<td>PHC</td>
<td>Primary heath care</td>
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<td>PhD</td>
<td>Doctor of Philosophy</td>
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<tr>
<td>RCT</td>
<td>Randomized Controlled Trial</td>
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<td>SD</td>
<td>Standard deviation</td>
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<td>SES</td>
<td>Socio-economic status</td>
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<td>SnF₂</td>
<td>Stannous fluoride</td>
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1. Introduction

Dental caries has been defined as "localized destruction of the tooth surface initiated by decalcification of the enamel followed by enzymatic lysis of organic structures and leading to cavity formation" (National Institute of Health, 2006). Although the disease is not life-threatening, it is a matter of great concern in dental public health because of its high prevalence in some of the developing countries (Petersen, 2003a; Anderson, 2002), its consequences such as pain, dysfunction etc., its impacts on the quality of life at all ages, and its social and economic burdens (Ismail, 2004; Robert & Sheiham, 2002).

Since implementation of a curative and restorative approach to combat dental caries at the population level does not appear to be cost-effective in many countries (Robert & Sheiham, 2002), the World Health Organization (WHO) has put more emphasis on prevention in setting global oral health goals for the year 2020 (Hobdell et al., 2003). In developing countries, the available resources for health care do not meet the costs of traditional curative care of dental diseases; thus preventive strategies should be implemented, as they are clearly more affordable and sustainable (WHO, 2003). The considerable decline in the prevalence and severity of dental caries following implementation of preventive strategies in the Scandinavian countries (König, 2004; Marthaler, 2004; Bratthal et al., 1996) supports the application of a preventive approach.

One of the requirements for the success of oral health promotion strategies is the availability of knowledgeable and prevention-orientated health service practitioners who serve individuals and groups in need for dental care (Gift, 1993). Because of the great influence of such a workforce on community health, promoting social responsibility and ethical practices of care givers has been emphasized by WHO as an objective for the year 2020 (Hobdell et al., 2003).

The Islamic Republic of Iran covers an area of 1.6 million km$^2$. The population of the country is about 70 million, with an annual growth rate of 1.5%. The country is divided into 30 provinces and 842 districts, with approximately 67% of the population living in urban areas (Iran Statistical Year Book, 2002). About half of the whole population is under the age of 20 (Iran Statistical Year Book, 2002), making Iran one of the youngest countries in the world (Pakshir, 2004).

Efforts to establish an integrated public health care service started in the 1940s finally led in 1979 to the establishment of an integrated network system to implement the Primary Health Care (PHC)
approach outlined by WHO in the Alma Ata conference (1978). Oral health care was integrated into this system in 1995 and the Dental Health care Delivery System (DHDS) was created. The Department of Oral Health in the Ministry of Health and Medical Education (MOHME) has administrative oversight over oral health care provision. Currently, oral health care services are delivered at four levels: health houses (in remote small villages), rural health centres (in large villages), urban health centres (cities), and district centres (cities). The health house staff, called "behvarz", offer oral health care including oral health education, periodic examination of the teeth, and referrals to the higher levels (rural or urban health centres). It also provides follow-up services to target groups in rural areas. At the second level, oral hygienists and dentists in rural health centres provide a variety of primary oral health care services, including fillings, pulpotomies, extractions of infected roots, fluoride therapy and scaling. At the third level, tertiary prevention, including management and treatment of oral and dental disease is provided by dentists, dental nurses and technicians in urban health centres. At the fourth level, advanced treatment is offered by specialists in university health centres. A national oral health promotion programme for children aged 6-12 years was initiated by the Department of Oral Health in 1997. Oral health education for the children and their parents by school health technicians and volunteer teachers, supervised tooth brushing together with weekly mouth rinsing with 0.2% sodium fluoride mouthrinse in the schools, and providing low-cost facilities for basic curative and preventive treatments are the components of this programme. (Pakshir, 2004)

With regard to the current burden of oral diseases in Iran, Pakshir (2003) has recommended a sharper focus on oral health promotion programmes based on the recently developed concepts of preventive oral care. Such programmes certainly require a prevention-oriented dental workforce. The present study, focusing on knowledge, attitudes and behaviour of dental school educators and dental students regarding prevention, investigated the present status of preventive dentistry in the dental education system in Iran.
2. Literature review

2.1. Preventive dentistry

2.1.1. Prevention of oral diseases

Although most oral diseases are not life-threatening, they are considered as major public health problems all over the world (WHO, 2006). There are several reasons for this concern.

The high prevalence of some oral diseases. Worldwide, the prevalence of dental caries among adults is high: the disease affects nearly 100% of the population in the majority of countries (Petersen et al., 2005). This is also true for periodontal diseases. The WHO Global Oral Health Data Bank shows that the symptoms of periodontal diseases are highly prevalent among adults in all regions, and signs of gingivitis can be found in most children and adolescents worldwide (Petersen et al., 2005; The World Oral Health Report, 2003). Throughout the world, tooth loss is widely seen as a natural consequence of ageing by many people. While some industrialized countries have seen a positive trend of reduction in tooth loss among adults in recent years, the proportion of edentulous adults aged 65 years and older is still high elsewhere (The World Oral Health Report, 2003).

The consequences of oral diseases. Oral diseases, if left untreated, lead to pain and discomfort. The psychosocial impact of these diseases also often significantly diminishes quality of life (The World Oral Health Report, 2003) and affects self-esteem and social confidence (Watt, 2005). Moreover, evidence has been presented suggesting an interrelationship between oral and general health. The strong correlation between several oral diseases and non-communicable chronic diseases is primarily a result of the common risk factors (The World Oral Health Report, 2003). Thus, the WHO has implemented a "common risk factor" strategy to control non-communicable diseases including oral diseases, with priority given to diseases linked by common, preventable and lifestyle-related risk factors (e.g. unhealthy diet, tobacco use) (WHO, 2000).

The financial burden of oral diseases on the communities. Dental diseases have been considered as the fourth most expensive to treat in industrialized countries (Petersen, 2004). There are also calculations indicating that the cost of restoring the permanent dentition of the child population using traditional restorative dentistry would exceed the whole budget for the provision of an
essential public health care package for the children in some of the low-income countries (Robert & Sheiham, 2002).

Accordingly, the development of accessible cost-effective oral health systems for the prevention and control of oral and craniofacial diseases has been set by WHO as one of the global goals to be achieved by the year 2020 (Hobdell et al., 2003). Effective preventive measures at individual, professional and community levels currently exist, but they are not implemented at an optimum level (Petersen, 2004). This, together with insufficient emphasis on primary prevention of oral diseases, poses a considerable challenge for many countries, particularly for developing countries with economies and health systems in transition.

2.1.2. Strategy approaches for prevention of oral diseases

Attempting to prevent a disease is worthwhile only if there is a risk of that condition to occur (Daly et al., 2005). "Risk" can be defined as "the probability that a particular outcome will occur due to the presence of specific risk factors or after exposure to a particular action or event" (Anderson, 2002). Preventive strategies seek to reduce risk by altering the determinants of the disease (Daly et al., 2005).

Based on the “risk” concept, strategy approaches can be classified into two categories: the population approach, and the risk approach, which in turn, is divided into the targeted population approach, and the high-risk approach. The population approach includes those strategies aimed at the whole population. While high-risk subgroups of the community are identified in the targeted population approach, the high-risk approach focuses on the individuals at increased risk of the disease (Batchelor & Sheiham, 2002). With regard to the polarization of many populations into a low-caries majority and a caries-active minority, there is a wide-spread emphasis on implementing a risk approach strategy in order to allocate resources efficiently (Pienihäkkinen et al., 2005; Pitts, 2004; Anderson, 2002; Bader et al, 2001; NIH, 2001). However, this approach has been criticized on account of its ineffectiveness in dealing with the majority of new lesions (Batchelor & Sheiham, 2002) and its lower impact on the oral health of the community in comparison with the whole population approach (Hausen et al., 2000).

In general, there are opportunities to apply preventive strategies at various levels. At the primary prevention level the goal is to prevent people from falling into risk groups by taking action before
the onset of disease. At the secondary prevention level, interventions are implemented to identify
the early onset of disease and to reduce risk factors. The target populations at the tertiary prevention
level are those with diagnosed conditions and controlled diseases. Here the goal is to prevent re-
ocurrence of disease and to promote oral health related quality of life. While an evidence-based
approach requires interventions at all these three levels, primary and secondary preventive actions
are more important because they are more affordable compared to interventions at the tertiary level.
(Spencer, 2003)

In the case of dental caries, dietary control or the use of fluoridated toothpaste to prevent the start of
the caries process are examples of primary prevention activities; the use of fluoride to arrest an
early carious lesion and application of fissure sealant to arrest an occlusal lesion can be considered
as secondary preventive actions; and finally, restoration of the tooth to restore form and function
and to arrest carious lesions is an example of action at the tertiary level (Daly et al., 2005).

At the public health level, because of the shortcomings of the "high-risk approach", it has been
argued that policy for caries-preventive strategies should be based on a "population" or "targeted
population" approach (Batchelor & Sheiham, 2002).

2.1.3. Socio-behavioural aspects of oral diseases
Public health research and policy analyses have highlighted the importance of social, economic and
environmental factors in determining health status (Daly et al., 2005; Nicolau et al., 2003). It is well
known that socio-behavioural factors greatly influence oral diseases, including dental caries
(Petersen, 2005). Figure 2.1 represents a model, suggested by WHO, to explain the association of
oral health conditions to various social and environmental factors (Petersen, 2003a). The factors,
According to this model, these factors can be placed on two levels: the distal level, including Health
system and oral health services, Socio-cultural risk factors, and, Environmental risk factors; and
the proximal level including Use of oral health services and Risk behaviour.

Health system and oral health services
Access to prevention-oriented dental care plays an important role in the oral health of the
population. However, availability of sufficient dental services is a challenge in many countries.
While in several developing countries services are centralized due to a shortage of dental manpower
and economic constraints (Petersen, 2005), provision of dental care has encountered some
disparities in some of the developed countries as well, mostly due to manpower shortages (Schwarz, 2006; Bedi, 2006), lack of sufficient public funding (Maas, 2006), cessation of supporting programmes (Schwarz, 2006), and a sharp rise in the demand for cosmetic dentistry (Bedi, 2006).

**Socio-cultural risk factors**

A substantial body of literature exists on the relationship between socio-cultural risk factors and oral health (Patrick et al., 2006; Newton & Bower, 2005; Zurriaga et al., 2004; Nicolau et al., 2003). Although socio-economic status (SES) is generally measured by several indicators such as income, education, occupational prestige, and place of residence (Krieger et al., 1997), it has been shown that these indicators do not influence health independently and some interrelations exist between at least some of them (Laahelma et al., 2004; Rahkonen et al., 2000). Several studies have shown relationship between SES-related inequalities and some disparities in oral health status (Hamasha et al., 2006; Antunes et al., 2006; Casanova-Rosado et al., 2005; Peres et al., 2005). A systematic review, however, has found that more studies are needed to identify SES-related factors that contribute to the risk of dental caries (Reisine & Psoter, 2001).
Environmental risk factors
With the growing evidence of a bilateral association between general and oral health, it seems necessary to take environmental risk factors into account when designing oral health promotion programmes (Sheiham & Watt, 2000). These factors are those related to drinking water, sanitation, hygiene, and nutrition status (Petersen, 2003a).

Use of oral health services
In addition to the availability of oral health services, there should be proper demand for them. Contrary to the situation in the majority of the developed countries, the reason for dental visits in many of the developing countries is experience of pain due to dental caries (Petersen, 2005), resulting in more emergency visits. Variation in service patterns also can be attributed to a number of other patient-related factors such as dental insurance, SES, and oral health status (Brennan & Spencer, 2005).

Risk behaviour
It is now widely accepted that oral diseases are mostly behaviour-related (Petersen, 2003a; Inglehart & Tedesco, 2000; Schou, 2000). A person’s attitude and behaviour regarding health in general, and oral health in particular, evolve during various stages of socialization throughout life (Freeman, 1999). Theoretical models explaining oral health status and behaviour consider past behaviours, other health-related behaviours, and psychomotor skills as behavioural factors (Chen et al., 1997; Inglehart & Tedesco, 1995). It has become clear that adopting and maintaining healthy habits including oral self-care (OSC) (Axelsson et al., 2002; Löe, 2000; Schou, 2000) and regular dental check-ups (Richards & Ameen, 2002; Ismail et al., 1994) play a crucial role in promoting oral health. Failure to achieve caries control by self-performed oral hygiene has been attributed to lack of compliance among individuals rather than ineffectiveness of the method used (Nyvad, 2003).

Because of its known detrimental effects on general and oral health (Reibel, 2003), tobacco use is currently considered to be a major public health problem that contributes significantly to the global oral disease burden (Petersen, 2003b). A clear relationship has been observed between oral and other upper aero-digestive tract cancers and alcohol consumption (Riedel et al., 2005) especially when combined with tobacco use (Ogden, 2005). In order to comply with WHO's common risk factors approach (2000), smoking and alcohol consumption, as two unhealthy habits, should be taken into account in designing community oral health promotion programmes (Morita et al., 2006; Petersen, 2003b; Jane-Salas et al., 2003).
2.1.4. Prevention of dental caries

Before the nineteenth century, in a period referred to as the pre-restorative era, dental treatment was confined to extraction of teeth and use of traditional remedies. With increased knowledge of the aetiology and management of dental caries, the restorative era started in late 19th century. The main focus of dentistry during this period was to preserve the teeth by various restoration techniques. (Ismail et al., 2001)

Since the restorative approach, as experiences in many developed countries showed, did not lead to improved oral health of the communities (Anusavice, 2005), a new main focus on prevention started to emerge in the recent decades (König, 2004; Ismail et al., 2001). In this preventive model of caries care, dentists should focus their efforts on monitoring, control and prevention, rather than on intervention (NIH, 2001).

2.1.4.1. Preventive non-operative dentistry

The concept of “preventive non-operative dentistry” (Pitts, 2004; Kidd & Nyvad, 2003) is based on the following principles:

1. Primary caries prevention. Primary caries prevention “is considered as an important activity at the population, group and individual level” (Pitts, 2004). A number of community- and individual-level strategies for preventing caries, with various degrees of effectiveness, have been used during the last three decades. These strategies include water fluoridation; the use of fluoride products in various forms (toothpaste, gels and varnishes); the use of chlorhexidine gels; pit and fissure sealant therapy; the use of products containing non-cariogenic sweeteners; and combinations of these methods (NIH, 2001).

2. Using appropriate diagnostic level. Diagnostic reasoning is a complex process which identifies the disease from its signs and symptoms and, at the same time, takes into account the consequences of the diseases for the patient (Nyvad, 2004). Because their restorative decisions significantly influence the oral health of the communities, dentists should try to detect early non-cavitated lesions in order to prevent them from progressing (Ismail, 2004). Dentists should understand that, in opposition to the prevailing view, the caries process is not synonymous with “cavities” (Ismail, 2004).
3. **Risk assessment.** Implementing a risk assessment approach in clinical practice, which can be defined as treating patients according to their individual risk of developing new caries, has been emphasized widely (Tranaeus et al., 2005; Sandberg, 2004; Kidd & Nyvad, 2003; Bader et al., 2003; Helminen et al., 1999; Varsio & Vehkalahti, 1997). This approach helps to identify the patients at increased risk in order to apply early and intensive preventive measures for them (NIH, 2001).

An individual’s risk of developing new caries depends on many factors, of which the most extensively documented ones are:

- Load of cariogenic bacteria, specially *Streptococcus mutans* in the mouth (and in mother’s mouth for infants) (Harris et al., 2004; Anderson, 2002)
- Presence of active caries and multiple restorations (Kidd & Nyvad, 2003; Bader et al., 2003; Anderson, 2002; NIH, 2001; American Dental Association, 1995)
- Poor oral hygiene (Pitts, 2004; NIH, 2001; ADA, 1995)
- Frequency, level and consistency of exposure to refined carbohydrates (Pitts, 2004; Anderson, 2002; NIH, 2001; ADA, 1995).

4. **Postponing surgical intervention.** Since the process of caries progression occurs as a result of imbalance in the demineralization-remineralization equilibrium, the dynamic nature of lesion progression allows for the arrest of further mineral loss by restoring the physiological equilibrium between tooth mineral and oral fluids (Fejerskov, 2004). Thus, evidence suggests that it is possible to arrest or reverse the process in early non-cavitated lesions through non-surgical strategies (Pitts, 2004; Kidd & Nyvad, 2003). Many of these strategies are the same as those mentioned above for primary caries prevention.

2.1.4.2. Strategies for the prevention of dental caries

In addition to the classifications stated above, preventive strategies can be classified based on the role and responsibility of the main decision-maker to carry them out (Figure 2. 2): Community-active measures, which need approval to be adopted, endorsed, funded, and carried out nationwide (e.g. water, milk, and salt fluoridation), dental professional-active measures, which are those taken by dentists, hygienists, and dental assistants to help individuals on a one-to-one basis (e.g. placement of sealants), and individual-active measures, which may be a wide variety of oral hygiene measures (e.g. using fluoridated toothpaste) (Davies, 2003).
**Fig. 2.2.** Classification of preventive measures for caries prevention based on the main decision-maker to implement them (adapted with permission from: Tseveenjav, 2004)

### Community-active measures

- Water fluoridation
- Salt and milk fluoridation

### Dental professional-active measures

- Fluoride varnish
- Professionally applied fluoride gels and foams
- Pit and fissure sealants
- Anti-microbial agents

### Individual-active measures

- Fluoridated toothpaste
- Fluoride supplements
- Fluoride mouthrinses
- Self-applied fluoride gels
- Self-applied chlorhexidine gels and rinses
- Slow-release fluoride devices
- Restriction of sugar consumption
- Non-cariogenic sweeteners

### Community-active measures for caries prevention

**Water fluoridation**

Fluoridation of drinking water has been the basis for primary caries prevention for more than five decades and has been recognized as one of the ten great achievements in public health (Truman et al., 2002). It is a cost-effective and practical method of reducing the SES-based disparities in the burden of dental caries (Australian Research Center for Population Oral Health, 2006; Burt, 2002). A recent systematic review of the effectiveness of water fluoridation concluded that based on before-after and post-exposure measurements in studies with comparison groups, water fluoridation seemed to reduce dental caries by 30% to 50%, and that stopping water fluoridation in situations in which alternative resources of fluoride are inadequate might lead to an 18% increase in caries (Truman et al., 2002). Another review limited to studies with both baseline and post-exposure
examinations found that in areas with fluoridated water the range of the mean increase in the proportion of children without caries was 5% to 64% (median=14.6), and the range of mean decrease in DMFT/dmft was 0.5-4.4 (median=2.25) compared to non-fluoridated areas (McDonagh et al., 2000).

The findings of a dose-dependent increase in dental fluorosis in fluoridated areas as well led the authors to conclude that "the evidence of a beneficial reduction in caries should be considered together with the increased prevalence of dental fluorosis". Further analyses, however, suggested that the risk might be substantially greater in naturally fluoridated areas, but less in artificially fluoridated areas (Petersen & Lennon, 2004).

Water fluoridation seems to be less effective in some of the developed countries with low caries activity and extensive exposure to various forms of fluoride than in others (Seppä, 2001).

Salt and milk fluoridation
Research on the evaluation of alternatives to water fluoridation, such as salt and milk fluoridation, began in the second half of the 20th century (Petersen & Lennon, 2004). The first studies of the effectiveness of salt fluoridation in caries prevention carried out from around 1965 to 1985 in Colombia, Hungary and Switzerland produced results that were rather similar to those obtained after the introduction of water fluoridation (Marthaler & Petersen, 2005). Salt fluoridation has been implemented in some countries in the western hemisphere (Vallejos-Sanchez et al., 2006; Gillespie & Baez, 2005; Meyer-Lueckel et al., 2002; Estupinan-Day et al., 2001) and in central and eastern European countries (Marthaler, 2005), resulting in caries reduction ranging from 14% in Germany (Marthaler, 2005) to 84% in Jamaica (Gillespie & Baez, 2005). Recently, an increased risk of fluorosis related to nationwide use of fluoridated salt was reported in Mexico (Vallejos-Sanchez et al., 2006). The first reports on milk fluoridation were from Switzerland in 1962. Since then, various channels have been used, including national programmes for the distribution of milk, powdered milk or milk cereal in kindergartens and schools (Jones et al., 2005). According to a recent review by Yeung et al. (2005) for the Cochrane Database of Systematic Reviews, despite the shortage of high-quality evidence on the effectiveness of milk fluoridation in caries reduction, existing studies suggest that fluoridated milk is beneficial to school children, especially for their permanent dentition. While fluoridated sugar and beverages, fluoride-rich mineral water, and other vehicles of fluoride seem to be of limited importance for caries prevention at the population level, they may be effective on an individual basis (Tseveenjav, 2004).
**Dental professional-active measures for caries prevention**

**Fluoride varnish**

Fluoride varnish, introduced in 1964, has been used widely in Europe since the 1980s (Adair, 2006). The quality of the evidences regarding the caries-preventive effect of fluoride varnish has been judged to range from insufficient (Petersson et al., 2004) to fair (Bader et al., 2001). In a systematic review, Petersson et al. (2004) reported a 30% (0-69) average pooled prevented fraction (the difference between the mean caries increment in the study and control groups divided by the mean increment in the control group [Adair, 2006]) for professional fluoride varnish treatment when compared to placebo or untreated controls. In a review by Marinho et al. (Cochrane Database of Systematic Reviews, 2002b), the pooled prevented fraction was reported to be 46% for permanent teeth and 33% for primary teeth, with no significant association with baseline caries severity or background exposure to fluoride in permanent dentition. The authors concluded that despite the relatively poor quality of the studies, fluoride varnish provided a substantial caries-inhibiting effect in both dentitions.

**Professionally applied fluoride gels and foams**

Trials of professionally applied fluoride gels, available as 1.23% Acidulated Phosphate Fluoride (APF) or 2% neutral sodium fluoride (NaF) formulations, were conducted mostly in the 1960s and 1970s. These trials reported a 20% pooled reduction in DMFS for once-yearly, and 26% for twice-yearly application (Adair, 2006). In a double-blind randomized controlled trial, van Rijkom et al. (2004) found a prevented fraction of 26% in permanent and 20% in primary dentition after twice yearly application of a 1% NaF gel, but only the reduction in the permanent dentition was statistically significant. The authors considered neither reduction to be “clinically relevant”. Based on a systematic review, Marinho et al. found clear evidence of the caries-inhibiting effect of fluoride gels with a 21% pooled prevented fraction for DMFS according to placebo-controlled trials (Cochrane Database of Systematic Reviews, 2002a). These authors, however, noted that there was little information concerning deciduous dentition.

Fluoride foams, available in the same formulations as gels, offer the advantage of requiring only about 20% as much product to achieve a fluoride deposition equivalent to that of the typical amount of gels in an application tray (Adair, 2006).
Pit and fissure sealants
The effectiveness of pit and fissure sealant therapy in reducing occlusal caries in the permanent teeth of high-risk children and adolescent has been documented in several clinical studies (Locker et al., 2003; Davies, 2003), although the quality of many of these studies was poorer than expected (Ahovuo-Saloranta et al., 2004). In a review of 24 studies from 1975 to 1990, Rozier (2001) reported a prevented fraction of 71% for fissure sealants. According to their review indicating prevented fraction of 33% for sealing first permanent molar, Mejare et al. (2003) concluded that the evidence for the preventive effect of fissure sealants was limited for first molars and incomplete for second molars. However, the review for Cochrane Database of Systematic Reviews by Ahovuo-Saloranta et al. (2004) reported a range of caries reduction from 86% at 12 months to 57% at 48-54 months follow-up. Accordingly, the authors recommended sealing with resin-based sealants to prevent caries of the occlusal surface of permanent molars, with paying attention to the caries prevalence level of both the individual and population. Longitudinal population-based studies also have shown that applying fissure sealants is cost-effective from public health point of view (Virtanen et al., 2003) with long-lasting preventive effects (Wendt et al., 2001).

Anti-microbial agents
Chlorhexidine gel, with a reported caries-preventive effect of 47% (Davies, 2003), can be effective in high-risk children (Rozier, 2001). A recent review concluded that the evidence for the anti-caries effect of the chlorhexidine-containing varnishes was inconclusive (Twetman, 2004). When used to interrupt vertical mother-to-child transmission, chlorhexidine has not been as effective as xylitol (Anderson, 2003). When used to prevent early childhood caries, a 10% povidone iodine solution has been reported to increase the time of "disease-free survival" in high-risk children (Twetman, 2004). Triclosan, a broad-spectrum biocide, has been incorporated into dentifrices together with a copolymer, but enhanced anti-caries effects were not found for triclosan/copolymer-containing fluoridated toothpastes in most of the caries-focused randomized controlled trials (RCT) (Twetman, 2004).

Individual-active measures for caries prevention
Fluoridated toothpaste
The evidence of the caries-inhibiting effect of fluoridated toothpaste is clear and strong for permanent dentition but incomplete for primary teeth (Marinho et al., 2003b; Twetman et al., 2003). There is no logical reason, however, to assume that it is less effective (Adair, 2006). In a study with
a placebo, a 24.9% prevented fraction in young permanent dentition has been attributed to use of fluoridated toothpaste (Twetman et al., 2003). The preventive effect of fluoridated toothpaste has been found to increase with higher baseline levels of caries, higher fluoride concentration, higher frequency of use, and supervised brushing; but not with exposure to water fluoridation (Marinho et al., 2003b). Extensive use of fluoridated toothpaste has been considered as one of the main reasons for recent declines in caries prevalence in developed countries (Bratthal et al., 1996). Convenient, inexpensive, culturally accepted, and widespread use of fluoridated toothpaste makes it an ideal public health measure (Burt, 1998). Thus, twice daily brushing with fluoridated toothpaste is recommended as a strong preventive strategy (Adair, 2006; Davies, 2003).

Fluoride supplements
Fluoride dietary supplements, with an estimated effectiveness of 20% to 30% reduction in dental caries, have been developed to benefit populations with no access to water-borne fluoride (Adair, 2006). However, a paradigm shift in fluoride's mode of effect from systemic to topical (Fejerskov, 2004; Hellwig & Lennon, 2004), exposure to other sources of fluoride, and the potential risk of fluorosis in permanent dentition weakened the role of fluoride supplements as a public health measure (Adair, 2006; Davies, 2003), so that they are now applicable as a preventive measure for compliant high-risk children (Davies, 2003).

Fluoride mouthrinses
Fluoride mouthrinses are available at a 0.2% concentration for weekly and a 0.05% concentration for daily use (Adair, 2006). With a prevented fraction of 26%, supervised regular use of fluoride mouthrinse at these two main strengths and rinsing frequencies is associated with a clear reduction in caries increment in the permanent dentition of children (Marinho et al., 2003a). Ideally, rinses should not be used when brushing so as to maintain a more or less constant concentration of fluoride throughout the day (Davies, 2003).

Self-applied fluoride gels
Self-applied fluoride gels are available as APF, neutral NaF and glycerin-based stannous fluoride (SnF₂, not true gel) products. Caries reduction following their use has been reported to be 32% in fluoride-deficient communities, and 7% to 35% in optimally fluoridated areas. No systematic reviews of purely self-applied gels have been conducted (Adair, 2006).
Self-applied chlorhexidine gels and rinses
The effectiveness of self-applied chlorhexidine gels and rinses has been reported to be the same as that of professionally applied products (Davies, 2003).

Slow-release fluoride devices
In a 2-year double-blind caries study, 67% fewer new carious teeth has been observed in children wearing a fluoride-releasing glass device in their mouths compared to the control group (Toumba, 2001). Such devices would be beneficial to prevent dental caries in non-compliant and high-risk children (Featherstone, 2006; Toumba, 2001).

Restriction of sugar consumption
The role of fermentable dietary carbohydrates in the initiation and development of dental caries has been well recognized. Although this role seems to be reduced in the modern age of fluoride exposure (Burt & Pai, 2001), and well-designed randomized clinical studies on the relationship between dietary factors and dental caries are still lacking (Lingstrom et al., 2003), restriction of sugar consumption remains an essential, if not the most important, aspect of caries prevention (Burt & Pai, 2001). Recommendations in this regard should be aimed at reducing the frequency and amount of sugar consumption by limiting it to mealtimes (Tseveenjav, 2004). According to a review, the acceptable level of non-milk extrinsic sugar consumption, based on the availability of the fluoride in the community, lies in a range from 10 to 15 kg/person/year (Sheiham, 1991).

Non-cariogenic sweeteners
A number of observational studies and clinical trials have shown the protective effect of xylitol, and to a lesser extent sorbitol, on caries incidence (Honkala et al., 2006; Burt, 2006; Anderson, 2003; Hayes, 2001). According to the comprehensive Finnish "Turku Sugar Study" (Scheinin et al., 1976), an 85% decline in dental caries was achieved by total dietary substitution of sucrose with xylitol over a 2-year period. Xylitol also can reduce the vertical transmission of Streptococcus mutans from mothers to children (Söderling et al., 2000). Promotion of the use of xylitol-sweetened gum has been proposed as a public health preventive measure (Burt, 2006; Honkala et al., 1996; Virtanen et al., 1996; Isokangas et al., 1989), although its use may be limited because of its high cost and low versatility (Tseveenjav, 2004).
2.2. Dental education

2.2.1. System

Dental education first started as an apprenticeship and then, with the establishment of the first college of dentistry at the University of Maryland (USA) over 150 years ago, it became an academic discipline (De Paola et al., 2002). Worldwide, several different dental educational traditions have been described. For example in Europe, dental education has been developed based on two different systems: stomatology (dentistry as a specialty of medicine) and odontology (dentistry as a single autonomous discipline) (Scott, 2003). This has led to some diversity in dental education and training on the continent (Gaengler et al., 2002). While stomatology provides a comprehensive medical background and a high level of surgical expertise, graduates of the odontological schools may be more expert in restorative and preventive dentistry (Scott, 2003). Generally the dental education systems in most developing countries are influenced by those of the developed countries (Phantumvanit, 1996; Sheiham, 1977).

The early objective of dental education was to train technically competent and biologically oriented dentists (Waldman, 1970) who were able to perform restorative treatments and provide curative care to individual patients (Ismail, 2001). The experiences in many developed countries, however, showed that this approach to training a dental workforce had no significant impact on the oral health of the community (Sheiham, 1977). Changes in the epidemiologic trends of oral diseases (Sheiham, 1977), increasing evidence of oral disease–systemic disease relationships (Hendricson & Cohen, 2001), growing evidence of the effectiveness of prevention, and gradual demographic and societal shifts (Graber et al., 1998) have led to calls to reform dental education. Moreover, surveys of the quality of education in the dental schools of developed countries have shown some deficiencies, such as a lack of sufficient emphasis on comprehensive care (Holmes et al., 2003), the weak linkage between medicine and dentistry (Kalkwarf et al., 2005) and a lack of relevance between basic and behavioural science and clinical practice (De Paola et al., 2002). To address these discrepancies both the content and methods of dental education should be modified accordingly (Walsh & Seymour, 2001).

2.2.1.1. Dental curriculum

The development of the dental curriculum in most countries has passed through three steps: "disease-oriented", "health-oriented" and "community-oriented" (Phantumvanit, 1996). Besides the
collaborative efforts by associations for dental education in Europe (ADEE) (Plasschaert et al., 2005) and the United States (ADEA) (Kalkwarf et al., 2005), dental institutions in Australia (Klineberg et al., 2002; Walsh & Seymour, 2001), Finland (Hietala et al., 2004; Kerosuo et al., 2001) and the United States (Licari & Knight, 2003; Sanders & Ferrillo, 2003) have tried to improve the quality of their education by curriculum revision. The key elements in these revisions are as follows:

- Developing ability to provide comprehensive care to patients (Hietala et al., 2004; Licari & Knight, 2003)
- Developing cultural competence and social responsibilities in the students (Sanders & Ferrillo, 2003; Kerosuo et al., 2001)
- Strengthening the links between basic biomedical and dental sciences (Sanders & Ferrillo, 2003; Kerosuo et al., 2001)
- Developing community-based education (Klineberg et al., 2002; Kerosuo et al., 2001; Walsh & Seymour, 2001)
- Establishing a strong biomedical research base (Sanders & Ferrillo, 2003)
- Developing skills for practice management (Sanders & Ferrillo, 2003)
- Developing interpersonal communication and teamwork skills (Kerosuo et al., 2001)
- Developing necessary skills for critical thinking, life-long learning and evidence-based dental practice (Kerosuo et al., 2001; Walsh & Seymour, 2001)

2.2.1.2. Educational approaches

Traditionally, teaching methods in dental schools have been based on memorization and recall of facts rather than life-long learning and problem solving (Gaengler et al., 2002). However, the inability of traditional teaching methodologies to promote self-directed learning, which is necessary in the current knowledge society, has become evident (Plasschaert et al., 2006). Innovative teaching and evaluation methods have been used in the dental schools, mainly in the three following domains:

**Competency-based instead of requirement-based education**

Competency has been defined as "behaviour expected of beginning independent practitioners", which "incorporates understanding, skills, and values in an integrated response to the full range of circumstances encountered in general professional practice" (Chambers & Gerrow, 1994).
Competency-based education has been accepted as a sound method for the design of instruction and assessment for undergraduate dental education (Plasschaert et al., 2002). It refers to the acquisition of the knowledge, skills and values related to the cognitive, psychomotor, and affective domains, and includes an integrated mechanism for evaluation and assessment (Boyd et al., 1996). In order to make it practical for European dental schools to implement competency-based dental education, the ADEE has defined the required competencies for European dentists in detail (Plasschaert et al., 2005) and this approach has been operationalized at the European level.

Since the traditional methods of students' evaluation may not cover new educational goals and objectives, and in response to the need for developing self-assessment ability among the dental students, innovative methods of assessment, such as Self- and peer-assessment, Performance-based assessment, Practical competence tests, etc. have been used in dental education (Manogue et al., 2002). For example, the OSCE (Objective Structured Clinical Examination) has been successfully implemented in some dental schools in the Netherlands (Schoonheim-Klein et al., 2006; 2005) and the UK (Brown et al., 1999; Manogue & Brown, 1998).

**Comprehensive care instead of discipline-based curricula**

The relationship between the basic biomedical, clinical, and behavioural sciences can be reinforced with an integrated curriculum design (Boyd et al., 1996). The comprehensive care model, when implemented as a part of curriculum revision, has been reported to be to the benefit of students’ skills and professional development (Hietala et al., 2004).

**Problem-based learning instead of traditional learning methods**

The promotion of problem solving skills in dental school curricula has been emphasized (Gaengler et al., 2002). Implementation of a problem-based learning (PBL) approach in undergraduate curricula in Ireland (Kelly et al., 1997), Singapore (Lim & Chen, 1999), Sweden (Rohlin et al., 1998), Finland (Kerosuo et al., 2001), and the Netherlands (Tack & Plasschaert, 2006) has shown promising results.

**2.2.2. Learning objectives in dental education**

Learning objectives in dental education, as in any academic programme, are defined and evaluated in three domains: cognitive, affective, and psychomotor (Martin, 2001; Boyd et al., 1996) or, more commonly, knowledge, attitude, and behaviour (Holmes et al., 2003).
2.2.2.1. Cognitive domain

The main purpose of dental education in the cognitive domain is to train a dental workforce that is knowledgeable enough to provide oral health care to individual patients and to the community (Phantumvanit, 1996). According to Bloom's taxonomy of learning domains, this domain consists of six hierarchical levels, beginning from the simple and building to the most difficult (Table 2.1) (Martin, 2001). Traditional educational methods based on recall and memorization can fulfil the objectives in lower levels of the hierarchy. Thus, the ability to think critically, which is considered as an important ability to be learnt during undergraduate training (Kerosuo et al., 2001), cannot be achieved using these traditional methods.

2.2.2.2. Affective domain

As an objective in the affective domain, promoting professional responsibility and positive attitudes among the dental students to serve the community has been emphasized widely (Rubin, 2004; Crossley & Mubarik, 2002; Waldman, 1970). An attitude can be defined as "a mixture of beliefs, thoughts and feelings that predispose a person to respond, in a positive or negative way, to objects, people, processes or institutions" (Brown et al., 2002). Despite the conception that it is difficult, if not impossible, to change the attitudes of students of dentistry (Reid, 1978; Waldman, 1970) some educational programmes with attitudinal objectives have shown varying degrees of success (Rubin, 2004; Bellas et al., 2000; Grantham & Block, 1983). There is some evidence suggesting that compared to traditional methods, new educational methods such as PBL are more successful in creating favourable attitudes in the dental students (Brown et al., 2002). As shown in Table 2.1, four steps must be taken before values become internalized and lead to behavioural changes.

In shaping the attitudes of the dental students towards various subjects, besides the training that dental students receive in the dental schools (Brown et al., 2002), their predetermined beliefs regarding the profession are also important (Waldman, 1970). The latter can be reflected in the students' motivations to choose dentistry as a career (Crossley & Mubarik, 2002), as well as in their career preferences after graduation. Previous efforts to find the main study motivations among the dental students, have found some common features, including altruistic motives (Vigild & Schwarz, 2001; Brand et al., 1996), career-related motives such as independence and regular work hours (Hallissey et al., 2000; Crossley & Mubarik, 2002; Brand et al., 1996), and motivations related to social status and high income (Scarbecz & Ross, 2002; Crossley & Mubarik, 2002). These studies have also shown that the dental students differ in their motivations based on such background
characteristics as gender, race, and parents' level of education (Stewart et al., 2005; 2004; Scarbecz & Ross, 2002). Studies on the career plans of dental students also show some similar patterns (Stewart et al., 2005; Butters & Winter, 1999; Winter & Butters, 1998).

Table. 2.1. Taxonomy of academic learning domains (modified from Martin, 2001).

<table>
<thead>
<tr>
<th>Hierarchical levels</th>
<th>Cognitive domain</th>
<th>Affective domain</th>
<th>Psychomotor domain</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1. Knowledge: recalling of data</td>
<td>1. Receiving Phenomena: an awareness; willingness to listen</td>
<td>1. Perception: the ability to use sensory cues to guide physical activity</td>
</tr>
<tr>
<td></td>
<td>2. Comprehension: understanding information</td>
<td>2. Responding to Phenomena: taking an active part in learning; participating</td>
<td>2. Set: a learner's readiness to act</td>
</tr>
<tr>
<td></td>
<td>3. Application: applying knowledge to a new situation</td>
<td>3. Valuing: the value a person attaches to something</td>
<td>3. Guided Response: the early stage of learning a complex skill which includes imitation</td>
</tr>
<tr>
<td></td>
<td>5. Synthesis: building a pattern from diverse elements</td>
<td>5. Internalizing Values: behaviour which is controlled by a value system</td>
<td>5. Complex Overt Response: the intermediate stage of learning a complex skill</td>
</tr>
<tr>
<td></td>
<td>6. Evaluation: judging the value of information</td>
<td></td>
<td>6. Adaptation: a learner's ability to modify motor skills to fit a new situation</td>
</tr>
<tr>
<td></td>
<td></td>
<td>7. Origination: a learner's ability to create new movement patterns</td>
<td></td>
</tr>
</tbody>
</table>

2.2.2.3. Psychomotor domain

The psychomotor domain refers to the use of basic motor skills, coordination, and physical movement (Martin, 2001). In dental education, training the skills related to manual practice and clinical performance lies in this domain. A learner should pass through seven steps to acquire a new ability in this domain (Table 2.1). The physical behaviours, according to this model, are learned through repetitive practice (Martin, 2001).

2.2.3. Dental education system in Iran

In Iran, those who have a secondary education diploma or a pre-university certificate for higher education can apply to sit the National University Entrance Examination in order to enter dental school. Of the 500,000 applicants for medical universities each year about 700 receive a passing
grade in the exam and start to study dentistry each year. An opportunity to study dentistry also
exists for a dental hygienist who has been trained for 3 years and has worked for 6 years in the
primary health care system. These applicants also must pass an entrance examination administrated
annually by MOHME. (Pakshir, 2003)

Currently there are 15 state and 3 private dental schools in Iran. Postgraduate training in ten
disciplines is offered by 7 schools, with a total annual admission of 100 students (Mohammadi et
al., 2004). Around 800 academic staff members work in various departments of all the schools.
Approximately 700 new dentists graduate each year (Pakshir, 2003).

The Iranian dental curriculum consists of 56 main subjects divided into 218 credits, as follows: 1)
general courses, 24 credits; 2) basic sciences, 44 credits; 3) predental courses, 35 credits, and 4)
dental courses, 115 credits. This programme should be taken over 6 years or 12 semesters (Pakshir,
2003).

Lack of a specific course in cariology or preventive dentistry in the Iranian undergraduate dental
curriculum has led to insufficient emphasis on primary prevention of oral diseases in the dental
schools (Sadr, 2001). Currently, some of the related topics are taught in Pedodontics, Operative
Dentistry, Periodontology and mainly Community Dentistry courses (Dental Education Programme,
2000). In the last revision of the curriculum, it has been tried to put more emphasis on prevention by
adding some practical courses on Community Dentistry to the curriculum (Pakshir, 2003).

2.3. Preventive activity among oral health professionals

2.3.1. Training a prevention-oriented dental workforce
Successful health promotion programmes require oral health professionals who are not only
knowledgeable and positively oriented towards prevention (Bellas et al., 2000), but also able to
properly implement preventive strategies (Johng-bai, 1998). Dentists and dental students (as future
dentists) carry out the main responsibility for promoting the oral health of the community. It
remains the responsibility of the dental education system to train a prevention-oriented workforce
that is able to implement preventive measures in order to promote the oral health of the community
(Plasschaert et al., 2005; Applewhite, 1969).
2.3.1.1. Prevention in dental education

The curative approach in dental education does not lead to better community oral health (Sheiham, 1997; 1977; Nadanovsky & Sheiham, 1995). Although the need for a focus on prevention in dental education has been emphasized widely (Pitts, 2004; Tseveenjav et al., 2002; NIH, 2001; Applewhite, 1969), the dental education curricula in many countries continue to give priority to the curative aspect (Plasschaert et al., 2002). The relationship between knowledge, attitude and practice seems to be stronger among professionals than among the lay population (Frank et al., 2004; Tseveenjav et al., 2004), meaning that it might be possible to train a prevention-oriented workforce.

In order to emphasize prevention in dental education, the ADEE has defined health promotion as a required major competency for European dentists (Plasschaert et al., 2005). The supporting competences in this domain have been defined as: Being competent in applying the principles of health promotion and disease prevention; Having knowledge of the organization and provision of health care in the community and in the hospital service; Being competent in understanding the complex interactions between oral health, nutrition, general health, drugs and diseases that can have an impact on oral health care and oral diseases; Having knowledge of the prevalence of the common dental conditions in the country of training/practice; Having knowledge of the importance of community-based preventive measures; and Having knowledge of the social, cultural and environmental factors which contribute to health or illness. The defined competences for dental licensure in Canada also include two statements regarding ability to assess the patient's dietary intake, oral hygiene status and effectiveness of self-care in order to promote oral health; and to provide appropriate preventive procedures for the patients (Boyd et al., 1996).

2.3.1.2. Prevention among dental school educators

The process of training a prevention-oriented dental workforce requires not only proper educational programmes (McGoldrick et al., 1998) and curricula (Polychronopoulou et al., 2002; Bellas et al., 2000), but also prevention-oriented academic staff (Frank et al., 2000, Elliot et al., 1994). The role of dental school educators is not confined to enhancing the knowledge of students. Their attitudes towards prevention, as a component of a “hidden curriculum” (Brown et al., 2002), also have potential effects on students’ competencies.

The prevention orientation of dental school educators has rarely been studied. A study from the 1970s showed that the plaque index and gingival index of Danish dental faculty differed
systematically based on the departments in which they worked (Lang et al., 1977). The studied indices were highest among the faculty members of Dental Materials, Anatomy, Histopathology, Microbiology, Oral Surgery, and Orthodontics departments. On the other hand, those in Operative Dentistry, Occlusion, Periodontics, Prosthodontics, Oral Diagnosis, and Comprehensive Dental Care departments exhibited the lowest scores. In a study done in the USA, 17.3% of the dental school faculty reported brushing three times a day, 40.5% reported flossing three times a week or more, and 74.4% reported visiting a dentist at least once a year (Weiss & Diserens, 1980).

2.3.2. Prevention among dentists and dental hygienists

Previous studies have shown some diversity in knowledge, attitudes and practice of dentists and dental hygienists regarding preventive dentistry. For example, dental hygienists in the USA (Forrest et al., 2000) as well as Korean dentists (Moon et al., 1998) underestimated the role of fluoride in caries prevention, but dentists from Finland recognized home use of supplementary fluoride as an important caries-preventive measure (Vehkalahti & Widström, 2004). While most of the Mongolian dentists appreciated the importance of fluoride in caries prevention, only about half of them were aware of the benefits of applying topical fluoride to children living in areas without fluoridated water supply, and only about one-third of them believed in the superiority of using fluoridated toothpaste over brushing per se in caries prevention (Tseveenjav, 2004).

Generally, previous studies have shown some dentist-related barriers to optimum implementation of preventive measures, such as deficiencies in applying fissure-sealants among Malaysian dentists (Abdul Razak & Lind, 1994), in applying topical fluoride among British dentists (Holloway et al., 1997) and American dental hygienists (Forrest, 2000), in efficient use of preventive measures for high-risk patients among Finnish dentists (Virtanen et al., 2003; Varsio et al., 1999; Varsio & Vehkalahti, 1997; 1996), and in offering preventive measures to symptomatic patients among Australian dentists (Brennan & Spencer, 2003). Beside these, such factors as insufficient reimbursement for prevention (Tomlinson & Treasure, 2006; Pine et al., 2004), patients' reluctance to pay for prevention (Tomlinson & Treasure, 2006), and lack of time owing to great demand for curative care (Tseveenjav et al., 2005) have been identified as limitations to applying preventive measures in general dental practice.

Compared to their population counterparts, dentists have reported better OSC habits resulting in better oral health (Tseveenjav et al., 2004). Studies on dentists’ children also have shown that their
oral health is better than that of their population counterparts (Tseveenjav, 2004; Ainamo & Holmberg, 1974; Tala, 1983).

2.3.3. Prevention among dental students

A study on Mongolian dental students showed that most of them believed in the importance of fluoride in caries prevention, but only about one-third of them recognized xylitol as a preventive measure, and the majority of Mongolian dentists were not aware of the superiority of using fluoridated toothpaste over brushing *per se* in caries prevention (Tseveenjav, 2004). The studies done by a standardized oral health knowledge and attitude inventory (HU-DBI) have indicated significant differences among dental students in many different countries (Barrieshi-Nusair, 2006; Rong et al., 2006; Al-Omari et al., 2006; Kawamura et al., 2005; 2002; 2001; 2000; 1997; Polychronopoulou & Kawamura, 2005; Komabayashi et al., 2005; Al-Wahadani, 2004), showing the importance of cross-cultural variations even among professionals.

Studies on preventive practice have mainly focused on dentists and dental auxiliaries, and such studies on dental students are rare. Mongolian dental students reported that they were more likely to recommend the use of fluoridated toothpaste and to do dietary counselling than to use topical fluoride and sealants (Tseveenjav, 2004).

Previous studies have reported better OSC habits among dental students compared to lay population (Tseveenjav et al., 2004; Cortes et al., 2002). Improvements in oral health behaviour (OHB) of Mongolian dental students during their professional trainings were reported to be negligible (Tseveenjav et al., 2003), while such improvements were reported to be significant among French (Cavaillon et al., 1982) and Spanish (Cortes et al., 2002) dental students.
3. Aim of the study

3.1. General aim
The general aim of this study was to assess the status of preventive dentistry in the Iranian dental education system by measuring the oral health professionals' (dental school educators and senior dental students) knowledge and attitudes towards prevention, OHB, preventive practice, study motivations, and career preferences.

3.2. Specific objectives
To achieve the aim, the following specific questions were asked:

1. How knowledgeable of preventive dentistry are dental school educators and dental students? (I, IV)
2. What attitudes do dental school educators and their students have towards preventive dentistry? (I, IV)
3. What are the determinants of knowledge and attitudes of the educators and their students towards prevention? (I, IV)
4. What do the educators and their students do to maintain and improve their own oral health? (I, II)
5. What are the determinants of OHB among the educators and their students? (I, II)
6. How do dental students practice preventive dentistry when seeing their patients? (III)
7. What are the determinants of prevention-oriented practice among the students? (III)
8. What are the main study motivations and career preferences among the dental students? (V)

3.3. Hypotheses
Oral health professionals with a better knowledge of and/or more positive attitudes towards preventive dentistry have better OHB and place more emphasis on preventive care when seeing their patients. Students’ study motivations can reflect their career orientation.
4. Material & Methods

4.1. Study background

According to a national survey conducted in 1998-1999 in Iran, the dmft of 3-year-old children was 1.8 and that of 6-year-olds was 4.8, with the d-component comprising over 90% of these indices (Oral Health Situation of Iranian Children, 2000). These figures show that dental caries in primary teeth is a major problem which should receive urgent attention. The DMFT of 12-year-olds was reported to be 2.4 in 1988 (Pakshir, 2004), 1.67 in 1993-1994 (Seyedeyn et al., 1998), and 1.5 in 1998-1999 with a D-component of 80% (Oral Health Situation of Iranian Children, 2000). Thus, although a clear decline can be seen in caries occurrence among 12-year-olds (Pakshir, 2004), the high proportion of decayed teeth among these children is alarming. The results of a survey on adults in 2002 also show the dominance of the D-component in the DMFT of 15-19- and 35-44-year-olds, which were reported to be 4.1 and 14.8 respectively (Pakshir, 2004).

4.2. Study population

The target population of this study comprised the dental school educators and the senior dental students (those at the last two semesters of study toward a Doctor of Dental Science degree) of the 15 state dental schools of Iran. The three private schools have different recruitment criteria, their students normally pay for their education, and they have some academic staff in common with the state schools. One of these private schools were selected for a pilot study, the other two were excluded.

To obtain a representative sample, a stratified cluster random sampling approach was implemented (Figure 4.1). Of the state schools six have been working for more than 30 years and nine have been established during the recent 25 years (Mohammadi et al., 2004). Based on this categorization, two strata were defined. Three old schools and four new ones were selected randomly to serve as clusters. Using self-administered questionnaires, the study was conducted in the selected schools.

4.3. Pilot study

A pilot study was performed in two stages. In order to revise the contents of the primarily structured questionnaires, a study with five educators and ten students was performed in the first stage. The questionnaires were finalized through further discussions with these groups. In the second stage, the
Fig. 4.1. The schematic process of sampling through the stages of stratification based on the age of the schools and random selection of three old and four new schools. The selected schools were treated as clusters.

15 state dental schools:

<table>
<thead>
<tr>
<th>School</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahvaz</td>
<td>Rasht</td>
</tr>
<tr>
<td>Babol</td>
<td>Shaheed Beheshti</td>
</tr>
<tr>
<td>Hamadan</td>
<td>Shiraz</td>
</tr>
<tr>
<td>Isfahan</td>
<td>Tabriz</td>
</tr>
<tr>
<td>Kerman</td>
<td>Tehran</td>
</tr>
<tr>
<td>Mashad</td>
<td>Yazd</td>
</tr>
<tr>
<td>Qazvin</td>
<td>Zahedan</td>
</tr>
<tr>
<td>Rafsanjan</td>
<td></td>
</tr>
</tbody>
</table>

N(educators)=800
N(students)=700

---

Stratification

6 old schools:

<table>
<thead>
<tr>
<th>School</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Isfahan</td>
<td></td>
</tr>
<tr>
<td>Mashad</td>
<td></td>
</tr>
<tr>
<td>Shaheed Beheshti</td>
<td></td>
</tr>
<tr>
<td>Shiraz</td>
<td></td>
</tr>
<tr>
<td>Tehran</td>
<td></td>
</tr>
</tbody>
</table>

N(educators)=420
N(students)=380

9 new schools:

<table>
<thead>
<tr>
<th>School</th>
<th>City</th>
</tr>
</thead>
<tbody>
<tr>
<td>Ahvaz</td>
<td></td>
</tr>
<tr>
<td>Babol</td>
<td></td>
</tr>
<tr>
<td>Hamadan</td>
<td></td>
</tr>
<tr>
<td>Kerman</td>
<td></td>
</tr>
<tr>
<td>Qazvin</td>
<td></td>
</tr>
<tr>
<td>Rafsanjan</td>
<td></td>
</tr>
<tr>
<td>Rasht</td>
<td></td>
</tr>
<tr>
<td>Tabriz</td>
<td></td>
</tr>
<tr>
<td>Yazd</td>
<td></td>
</tr>
<tr>
<td>Zahedan</td>
<td></td>
</tr>
</tbody>
</table>

N(educators)=380
N(students)=320

---

Random selection

7 selected schools (clusters)

<table>
<thead>
<tr>
<th>Old schools</th>
<th>New schools</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mashad</td>
<td>Ahvaz</td>
</tr>
<tr>
<td>Shaheed Beheshti</td>
<td>Hamadan</td>
</tr>
<tr>
<td>Tehran</td>
<td>Kerman</td>
</tr>
<tr>
<td>Qazvin</td>
<td></td>
</tr>
</tbody>
</table>

N(educators)=363
N(students)=327

---
feasibility of the study method was tested by conducting a study in one of the three private schools.

4.4. Data collection

The author visited the selected schools in the spring term of 2005, staying two working days in each. A list of the educators and of senior dental students was obtained in each school. All of the educators present in their departments on the day data were collected were asked one by one to voluntarily fill in the questionnaire and return it immediately. The students' questionnaire was then delivered to the volunteer students in their ordinary classroom settings to be returned immediately. The administrative officials assisted in distributing and collecting the questionnaires.

Totally, 290 educators (80%) and 271 students (82%) participated in the study (Tables 4.1 and 4.2).

4.5. Theoretical model of the study

Based on a previously presented model to show the relationship between knowledge, attitude and practices (Brown et al., 2002), a theoretical model for this study of preventive dentistry among oral health professionals was developed (Figure 4.2). According to this model, knowledge, attitude, understanding and competency are predispositions to act. By putting the three domains of academic learning behaviour viz. cognitive (knowledge), affective (attitude), and psychomotor (practice) domains (Martin, 2001), in bilateral associations with each other, this model assumes that it is possible to predict one from the other and to modify one by changing the other (Brown et al., 2002). Attitude, as the core component in this model, is affected by background factors and previous behaviours (which have been formed before professional training), and, in turn, shapes the future behaviours and actions during the process of academic education. The outcomes are OSC and preventive practice among oral health professionals.
Table 4.1. Background characteristics of Iranian dental school educators (n=291).

<table>
<thead>
<tr>
<th>Gender</th>
<th>All (n=291)</th>
<th>Men (n=175)</th>
<th>Women (n=116)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>41</td>
<td>43</td>
<td>38</td>
</tr>
<tr>
<td>Mean amount of teaching experience (years)</td>
<td>11</td>
<td>12</td>
<td>8</td>
</tr>
<tr>
<td>Academic degree (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS</td>
<td>11</td>
<td>11</td>
<td>10</td>
</tr>
<tr>
<td>MS or PhD</td>
<td>89</td>
<td>89</td>
<td>90</td>
</tr>
<tr>
<td>Familiarity with OPH* field (%)</td>
<td>29</td>
<td>33</td>
<td>22</td>
</tr>
<tr>
<td>Yes</td>
<td>71</td>
<td>67</td>
<td>78</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Oral Public Health

Table 4.2. Background characteristics of Iranian senior dental students (n=270).

<table>
<thead>
<tr>
<th>Gender</th>
<th>All (n=270)</th>
<th>Men (n=116)</th>
<th>Women (n=154)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mean age (years)</td>
<td>26</td>
<td>28</td>
<td>24</td>
</tr>
<tr>
<td>Parent employed as a dentist (%)</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>7</td>
<td>9</td>
<td>6</td>
</tr>
<tr>
<td>No</td>
<td>93</td>
<td>91</td>
<td>94</td>
</tr>
<tr>
<td>Dental hygienist background (%)</td>
<td>12</td>
<td>27</td>
<td>1</td>
</tr>
<tr>
<td>Yes</td>
<td>88</td>
<td>73</td>
<td>99</td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

4.6. Questions and variables

4.6.1. Background information

The educators were asked to indicate their gender and year of birth as personal background. Information on the educators' highest academic degree (DDS, Master of Science, Doctor of Philosophy), the duration of their tenure as dental school educators, and the department in which they worked was requested to serve as academic background. In two separate questions they were also asked to show how acquainted they were with the discipline of Oral Public Health, and how much working or teaching experience they had in that field. The alternatives for the responses were: very much, quite a bit, a little and not at all. Combining these two questions, being familiar with the field of Oral Public Health (OPH) was defined as knowing quite a bit or very much about the field and having some experience in it.
In addition to giving their gender and year of birth, the students were asked to report if they had a parent employed in dentistry and if they had a background in dental hygiene.

Tables 4.1 and 4.2 show the distribution of the participants according to their background factors.

4.6.2. Knowledge and attitudes towards prevention

The educators and the students were asked to react to nine statements regarding various aspects of caries diagnosis and prevention on a five-point Likert scale ranging from completely agree to completely disagree (see Appendix). The responses were then scored from one to five according to the degree of the respondent's knowledge. The scores were summed in order to calculate final knowledge scores. For further analysis, the final scores were subdivided into quartiles of possible scores from 9 to 45.

A seven-point semantic differential scale of five qualities and their opposites was used to record the respondents' attitudes towards preventive dentistry. The qualities were: *Costly for the dentist* – *Beneficial to the dentist*, *Useless for the community* – *Useful for the community*, *Non-prestigious* – *Prestigious*, *Non-essential* – *Essential*, and *Difficult* – *Simple*. Giving score to the responses (from one to seven, with the higher scores for the more favourable attitudes), and calculating final attitude
scores was done as described above for knowledge. Quartiles of final scores were defined according to the range of possible scores, from a minimum of 5 to a maximum of 35.

4.6.3. Oral health behaviour

**OSC habits**
The respondents were requested to report the frequency with which they brushed their teeth, used fluoridated toothpaste, flossed and ate sugary snacks between main meals. These questions had from four to seven alternatives (see Appendix). In order to define acceptable levels of each of the OSC components, the following cut-off points were used: brushing more than once a day, using fluoridated toothpaste always or almost always, flossing at least once a day, and eating sugary snacks between main meals less frequently than once a day.

A recommended level of OSC was defined as a combination of brushing more than once a day and using fluoridated toothpaste always or almost always.

**Dental service utilization**
The respondents were asked to indicate the provider of their own dental check-ups (with the alternatives: a dentist, a colleague [for educators] or a classmate [for students], myself, and no need) and the time of the last check-up (with seven alternatives [see Appendix]). Attending a dental check-up within the last year by a colleague, a classmate or a dentist was defined as preventive care use.

**Smoking habits**
The questionnaire requested information on the respondents’ habits of cigarette and pipe smoking separately. The questions had six alternatives (see Appendix). To dichotomize the variable, those who reported no present smoking habits were considered as non-smokers.

4.6.4. Prevention-oriented practice and self-perceived competency in provision of preventive care
A brief history and results of a clinical examination of two hypothetical cases, one with high risk of caries development and one with low risk, were presented to the students. The high-risk case (an 18-year-old boy) was characterized by presence of multiple dental caries and previous restorations
in the mouth, visible plaque on dental surfaces, and poor oral hygiene. The low-risk patient was a 22-year-old girl with one filled and one decayed tooth who brushed her teeth regularly twice a day. A five-point Likert scale from “completely agree” to “completely disagree” assessed the dental students’ reactions to each of the nine alternatives given for both patients’ treatment plans, viz. filling irreversibly decayed teeth; giving instructions on tooth brushing, flossing and home use of fluoridated mouth rinses; giving advice on the use of fluoridated toothpaste; fluoride therapy; professional prophylaxis; dietary counselling; and a check-up interval (3-6 months for the high-risk and 9-12 months for the low-risk patient). The students’ responses for prevention-related alternatives (excluding the alternative for filling irreversibly decayed teeth for both of the patients) were scored from 1 to 5, with the highest scores for favourable responses (i.e. “agree” or “completely agree” for all the alternatives, except home use of fluoride mouth rinse, fluoride therapy, dietary counselling and professional prophylaxis for the low-risk patient). By summing the scores, the final practice scores were calculated and sub-grouped into quartiles (Q1 to Q4) of possible scores from 16 to 80.

As another outcome measure, acceptable preventive practice was defined as a combination of agreement on dietary counselling for the high-risk case and on giving instructions for tooth brushing and using fluoridated toothpaste to both of the patients.

In five separate questions, students were requested to assess their self-perceived competency in giving oral hygiene instructions, dietary counselling, applying topical fluoride, applying fissure sealants and managing patients at high risk of developing caries. Alternatives were very competent, quite competent, not very competent, and not at all competent and I have never done that. In order to dichotomize the variable, those who chose very competent or quite competent were considered as competent and others as not competent.

4.6.5. Motives to study dentistry and career preferences

To assess their motives to study dentistry, the students were asked to give a score from 0 to 5 to each of the 12 given alternatives according to the degree the alternative had influenced their decision to study dentistry. The alternatives were: Failure to be admitted to other programmes, Parents' recommendation, Friends' or relatives' recommendation, Personal interest in dentistry, Interest in working with one’s hands, Existence of artistic theme in dentistry, High income from practicing dentistry, Ability to be self-employed, Social status of being a dentist, Helping people to
improve their health, Playing a role in community health promotion, and Being a researcher in dentistry. The mean of the scores for each alternative was calculated in order to rank the motivations and to facilitate comparisons between the subgroups.

In order to assess their career preferences, the students were asked to indicate their willingness to work in each of the nine available fields in dentistry after graduation by giving a score from 0 to 5. The alternatives were then categorized as follows: 1) Private practice: To be a solo practitioner in private office, to work in a clinic as an independent contractor, to be a shareholder in an incorporated practice; 2) Employment: To be employed on salary or commission in a governmental organization, to be employed on salary or commission in a private organization; 3) Community oral health and research: To work as a dentist in the primary health care system, to work or study in the field of oral public health, to be a researcher in dentistry; 4) Higher education: Entering a postgraduate programme. For each respondent, the mean scores of the four categories were calculated separately in order to produce career choice scores. Based on these scores, the career preference was defined as the category with the highest score.

4.7. Statistical methods

Chi-square test was used to evaluate the statistical significance of differences in frequencies between subgroups. Binary logistic regression models were fitted to the data to evaluate the association of outcome measures with explanatory factors and to calculate corresponding odds-ratios (OR) and 95% confidence intervals (CI).

Using a factor analysis with principle component method and varimax rotation, the underlying dimensions for study motives were identified. Each item that loaded at 0.60 or greater on only one factor was included as an item for a given factor (Nie et al., 1975). Based on the factor analysis, new variables vis-à-vis each factor were formed by summing the values of the original variables with the highest loadings in that factor. These sum variables were then standardized by dividing the sum by the number of variables included (Scarbecz & Ross, 2002).
5. Results

5.1. How knowledgeable and positively oriented are dental school educators and dental students towards preventive dentistry? (I, IV)

5.1.1. Knowledge and attitudes towards prevention among educators and students

More than 90% of the educators and the students were aware of the caries-preventive effects of limiting frequency of sugar intake, adding fluoride to the drinking water, and applying fissure sealants. However, less than 15% of them believed that fluoridated toothpaste is more beneficial than brushing *per se* for caries prevention (Figure 5.1). Regarding the attitudes, preventive dentistry was characterized as “Useful for the community” and “Essential” by more than 80% of the respondents, but less than 40% of them identified it as “Beneficial for the dentist” and “Prestigious” (Figure 5.2).

Knowledge scores of 12% of the educators and 14% of the students were in the highest quartile. The corresponding figures for the attitudes scores for the educators and students were 32% and 31% respectively. The differences in the knowledge and attitudes scores between the educators and the students were not significant.

5.1.2. Determinants of knowledge and attitudes towards prevention among educators and students

Based on having received a score in the highest quartile, educators working in the departments of Pedodontics, Operative Dentistry or Periodontology were more knowledgeable than those working in the other departments (P=0.04). Female educators, as well as those who were familiar with the field of OPH reported more positive attitudes towards preventive dentistry compared to the others (P=0.05). No significant differences related to background factors were found among the students (Table 5.1).
Fig. 5.1. The percentages of Iranian dental school educators (n=291) and dental students (n=270) who agreed with the statements given about caries prevention.

- Using fluoridated toothpaste is more important than the brushing per se for preventing caries.
- A white- or brown-spot lesion that is visible on a wet tooth surface has penetrated all the way through the enamel.
- Examining a newly erupted tooth with a sharp explorer damages the enamel rods and makes the tooth vulnerable to caries.
- Rinsing teeth with a lower amount of water after tooth-brushing increases the effect of fluoride.
- Compared to a sound tooth, the probability of losing a restored tooth is greater.
- Having dental problems can lead to general health problems.
- Sealant is effective in the prevention of pit and fissure caries in newly erupted molars.
- Fluoridation of drinking water is an effective, safe, and efficient way to prevent dental caries.
- The frequency of sugar consumption has a greater role in producing caries than does the total amount of sugar consumed.
**Fig. 5.2.** The percentages of Iranian dental school educators (n=291) and dental students (n=270) who characterized preventive dentistry as being in the favourable side (score 5, 6 or 7) of the given qualities in the semantic differential scale.

**Table 5.1.** The percentages of Iranian dental school educators (n=291) and senior dental students (n=270) with highest knowledge and attitude scores in various subgroups based on their background characteristics.

<table>
<thead>
<tr>
<th></th>
<th>Highest knowledge scores (quartile 4)</th>
<th>p*</th>
<th>Highest attitude scores (quartile 4)</th>
<th>p*</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Educators</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Gender</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Women</td>
<td>12</td>
<td>36</td>
<td>0.85</td>
<td>0.05</td>
</tr>
<tr>
<td>Men</td>
<td>13</td>
<td>25</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Academic degree</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>DDS</td>
<td>11</td>
<td>37</td>
<td>0.74</td>
<td>0.44</td>
</tr>
<tr>
<td>MS or PhD</td>
<td>13</td>
<td>30</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Department of teaching</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Pedodontics, Operative Dentistry, Periodontology</td>
<td>20</td>
<td>27</td>
<td>0.04</td>
<td>0.46</td>
</tr>
<tr>
<td>Other departments</td>
<td>10</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Familiarity with the field of OPH**</td>
<td>18</td>
<td>39</td>
<td>0.16</td>
<td>0.05</td>
</tr>
<tr>
<td>Yes</td>
<td>12</td>
<td>31</td>
<td></td>
<td></td>
</tr>
<tr>
<td>No</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Total</td>
<td><strong>14</strong></td>
<td><strong>31</strong></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

| **Students**             |                                      |    |                                     |    |
| Gender                   |                                      |    |                                     |    |
| Women                    | 11                                   | 33 | 0.77                                | 0.76|
| Men                      | 12                                   | 32 |                                     |    |
| Parent employed as a dentist |                                      |    |                                     |    |
| Yes                      | 16                                   | 32 | 0.55                                | 0.90|
| No                       | 11                                   | 33 |                                     |    |
| Dental hygienist background |                                      |    |                                     |    |
| Yes                      | 6                                    | 27 | 0.40                                | 0.49|
| No                       | 12                                   | 33 |                                     |    |
| Total                    | **12**                               | **32** |                                     |    |

*Chi-square test was used to evaluate statistical differences between subgroups.
**Oral Public Health
5.2. What do dental school educators and the dental students do to improve their own oral health? (I, II)

5.2.1. Oral health behaviour among educators and students

Table 5.2 represents the distribution of OHB components among the educators and the students. While twice-a-day brushing was more frequent among the educators (67%) than the students (57%) (P=0.02), the students reported more frequent use of fluoridated toothpaste compared to the educators (76% vs. 65%, P=0.01). The differences between the educators and the students in the other components remained insignificant.

Table 5.2. The percentages of Iranian dental school educators (n=291) and senior dental students (n=270) with acceptable levels of each of the OHB components.

<table>
<thead>
<tr>
<th>Oral health professionals</th>
<th>Educators %</th>
<th>Students %</th>
<th>P *</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Brushing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least twice a day</td>
<td>67</td>
<td>57</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Using fluoridated toothpaste</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Always or almost always</td>
<td>65</td>
<td>76</td>
<td>0.01</td>
</tr>
<tr>
<td><strong>Flossing</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>At least once a day</td>
<td>55</td>
<td>52</td>
<td>0.51</td>
</tr>
<tr>
<td><strong>Sugary snacks</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Less than once a day</td>
<td>45</td>
<td>40</td>
<td>0.20</td>
</tr>
<tr>
<td><strong>Preventive care use</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>52</td>
<td>54</td>
<td>0.70</td>
</tr>
<tr>
<td><strong>Fulfilling criteria for recommended OSC</strong></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>42</td>
<td>47</td>
<td>0.21</td>
</tr>
</tbody>
</table>

*Chi-square test was used to evaluate statistical differences between students and educators.

Regarding the smoking habits of the educators, current cigarette or pipe smoking habits were reported by 22% and 3% of men, respectively, and by none of the women. The reported frequency of twice-a-day brushing, and use of fluoridated toothpaste was higher among the non-smokers (P=0.02 and P=0.04, respectively) than among other men.

5.2.2. Determinants of oral health behaviour among educators and students

In the binary logistic regression models, fulfilling criteria for recommended OSC among the educators was associated with female gender (OR=2.7, P=0.003) and familiarity with the field of OPH (OR=2.6, P=0.01) (Table 5.3).
Table 5.3. Association of the personal and academic characteristics, preventive knowledge, and attitude towards prevention with recommended OSC among Iranian dental school educators (n=291) in a binary logistic regression model.

<table>
<thead>
<tr>
<th></th>
<th>E.S.*</th>
<th>S.E.**</th>
<th>P</th>
<th>OR</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female gender</td>
<td>0.985</td>
<td>0.335</td>
<td>0.003</td>
<td>2.7</td>
<td>1.4-5.2</td>
</tr>
<tr>
<td>At least 10 years of teaching experience</td>
<td>-0.530</td>
<td>0.319</td>
<td>0.10</td>
<td>0.6</td>
<td>0.3-1.1</td>
</tr>
<tr>
<td>Having MS or PhD degree</td>
<td>-0.100</td>
<td>0.553</td>
<td>0.86</td>
<td>0.9</td>
<td>0.3-2.7</td>
</tr>
<tr>
<td>Familiarity with OPH</td>
<td>0.968</td>
<td>0.367</td>
<td>0.01</td>
<td>2.6</td>
<td>1.3-5.4</td>
</tr>
<tr>
<td>Teaching in certain departments***</td>
<td>-0.149</td>
<td>0.345</td>
<td>0.67</td>
<td>0.9</td>
<td>0.4-1.7</td>
</tr>
<tr>
<td>Smoking</td>
<td>0.791</td>
<td>0.488</td>
<td>0.11</td>
<td>2.2</td>
<td>0.9-5.7</td>
</tr>
<tr>
<td>Highest scores of preventive knowledge (quartile 4)</td>
<td>-0.002</td>
<td>0.456</td>
<td>0.99</td>
<td>1.0</td>
<td>0.4-2.4</td>
</tr>
<tr>
<td>Highest scores of attitude towards prevention (quartile 4)</td>
<td>-0.237</td>
<td>0.344</td>
<td>0.49</td>
<td>0.8</td>
<td>0.4-1.6</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.835</td>
<td>1.729</td>
<td>0.10</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hosmer-Lemeshow goodness-of-fit test significance P>0.05 for the model.
* Estimate of Strength
** Standard Error
***Departments of Pedodontics, Operative Dentistry and Periodontology

Among the students, women (OR=2.6, P=0.001) and students with more positive attitudes towards preventive dentistry (OR=1.7, P=0.05) were more likely to fulfil the criteria for recommended OSC (Table 5.4).

Table 5.4. Association of the background characteristics, preventive knowledge, and attitude towards prevention with recommended OSC among Iranian senior dental students (n=270) in a binary logistic regression model.

<table>
<thead>
<tr>
<th></th>
<th>E.S.*</th>
<th>S.E.**</th>
<th>P</th>
<th>OR</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td>Female gender</td>
<td>0.940</td>
<td>0.286</td>
<td>0.001</td>
<td>2.6</td>
<td>1.5-4.5</td>
</tr>
<tr>
<td>Dentist as a parent</td>
<td>-0.453</td>
<td>0.521</td>
<td>0.39</td>
<td>0.7</td>
<td>0.2-1.8</td>
</tr>
<tr>
<td>Dental hygienist background</td>
<td>-0.855</td>
<td>0.511</td>
<td>0.09</td>
<td>0.4</td>
<td>0.2-1.2</td>
</tr>
<tr>
<td>Highest scores of preventive knowledge (quartile 4)</td>
<td>0.387</td>
<td>0.402</td>
<td>0.34</td>
<td>1.5</td>
<td>0.7-3.2</td>
</tr>
<tr>
<td>Highest scores of attitude towards prevention (quartile 4)</td>
<td>0.554</td>
<td>0.279</td>
<td>0.05</td>
<td>1.7</td>
<td>1.0-3.0</td>
</tr>
<tr>
<td>Constant</td>
<td>-2.211</td>
<td>0.975</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hosmer-Lemeshow goodness-of-fit test significance P>0.05 for the model.
* Estimate of Strength
** Standard Error
5.3. How do dental students practice preventive dentistry? (III)

5.3.1. Prevention-oriented practice of students

As shown in Table 5.5, at least three quarters of the students agreed with including the alternatives: *Giving instructions on brushing*, *Recommending use of fluoridated toothpaste*, *Giving instructions on flossing*, and *Adjusting the given check-up intervals* for the high- and low-risk cases. Less than 50% of the respondents believed that the other alternatives should be included for the low-risk patient.

Table 5.5. The percentages of Iranian senior dental students (n=270) who agreed with including the given alternatives in the treatment plans of the high-risk case and the low-risk case.

<table>
<thead>
<tr>
<th></th>
<th>High-risk patient (%)</th>
<th>Low-risk patient (%)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Giving instructions on brushing</td>
<td>95</td>
<td>80</td>
</tr>
<tr>
<td>Recommending use of fluoridated toothpaste</td>
<td>75</td>
<td>75</td>
</tr>
<tr>
<td>Giving instructions on flossing</td>
<td>94</td>
<td>90</td>
</tr>
<tr>
<td>Instructing in use of NaF mouth rinse</td>
<td>57</td>
<td>47</td>
</tr>
<tr>
<td>Doing fluoride therapy</td>
<td>42</td>
<td>32</td>
</tr>
<tr>
<td>Doing professional prophylaxis</td>
<td>67</td>
<td>44</td>
</tr>
<tr>
<td>Dietary counselling</td>
<td>69</td>
<td>46</td>
</tr>
<tr>
<td>Adjusting check-up intervals</td>
<td>84</td>
<td>87</td>
</tr>
</tbody>
</table>

Regarding the preventive practice score, 23% of the students acquired a score in the highest, 73% in the third, 4% in the second, and none in the lowest quartile. Based on the defined criteria, the practice of preventive dentistry of 44% of the students was considered acceptable.

5.3.2. Factors associated with students’ prevention-oriented practice

Acquiring a score in the highest quartile was more frequent among students with recommended OSC (30% vs. 16%, P=0.01), those with more positive attitudes towards prevention (31% vs. 19%, P=0.03), and those with more self-perceived competency in giving preventive care (28% vs. 15%, P=0.02) compared to other students. Reporting acceptable preventive practice scores was more frequent among female students (49% vs. 37%, P=0.05), students with recommended OSC (53% vs. 38%, P=0.02), and students with more extensive knowledge of prevention (74% vs. 41%, P=0.001) than the others (Table 5.6).
Table 5.6. The percentages of Iranian senior dental students (n=270) with highest and acceptable preventive practice scores in various subgroups based on their background characteristics, levels of OSC, preventive knowledge, attitudes towards preventive dentistry, and competency in giving preventive care.

<table>
<thead>
<tr>
<th></th>
<th>Highest preventive practice scores (quartile 4)</th>
<th></th>
<th>Acceptable preventive practice</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>%</td>
<td>P *</td>
<td>%</td>
<td>P *</td>
</tr>
<tr>
<td><strong>Gender</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Men</td>
<td>18</td>
<td>0.17</td>
<td>37</td>
<td>0.05</td>
</tr>
<tr>
<td>Women</td>
<td>26</td>
<td>0.26</td>
<td>49</td>
<td>0.44</td>
</tr>
<tr>
<td><strong>Parent employed as a dentist</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>11</td>
<td>0.28</td>
<td>53</td>
<td>0.18</td>
</tr>
<tr>
<td>No</td>
<td>23</td>
<td>0.01</td>
<td>43</td>
<td>0.02</td>
</tr>
<tr>
<td><strong>Dental hygienist background</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>15</td>
<td>0.99</td>
<td>33</td>
<td>0.001</td>
</tr>
<tr>
<td>No</td>
<td>24</td>
<td></td>
<td>38</td>
<td></td>
</tr>
<tr>
<td><strong>Recommended OSC</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Yes</td>
<td>30</td>
<td></td>
<td>53</td>
<td></td>
</tr>
<tr>
<td>No</td>
<td>16</td>
<td>0.02</td>
<td>38</td>
<td>0.07</td>
</tr>
<tr>
<td><strong>Preventive knowledge</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest scores (quartile 4)</td>
<td>23</td>
<td>0.03</td>
<td>74</td>
<td>0.13</td>
</tr>
<tr>
<td>Lower scores (quartiles 2 &amp; 3)</td>
<td>23</td>
<td></td>
<td>41</td>
<td></td>
</tr>
<tr>
<td><strong>Attitude towards prevention</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Highest scores (quartile 4)</td>
<td>31</td>
<td></td>
<td>51</td>
<td></td>
</tr>
<tr>
<td>Lower scores (quartiles 2 &amp; 3)</td>
<td>19</td>
<td>0.02</td>
<td>41</td>
<td></td>
</tr>
<tr>
<td><strong>Competency in giving preventive care</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Competent (%)</td>
<td>28</td>
<td></td>
<td>49</td>
<td></td>
</tr>
<tr>
<td>Not competent (%)</td>
<td>15</td>
<td></td>
<td>38</td>
<td></td>
</tr>
<tr>
<td><strong>Total</strong></td>
<td>23</td>
<td></td>
<td>44</td>
<td></td>
</tr>
</tbody>
</table>

*Chi-square test was used to evaluate statistical differences between subgroups.

According to the regression model (Table 5.7), acquiring a preventive practice score in the highest quartile was associated with fulfilling criteria for recommended OSC (P=0.05, OR=1.9) and reporting to be competent in giving preventive care (P=0.04, OR=2.0).

Table 5.7. Association of the selected factors with *acquiring a score in the highest quartile of preventive practice scores* among Iranian senior dental students (n=270) in a binary logistic regression model.

<table>
<thead>
<tr>
<th></th>
<th>E.S.*</th>
<th>S.E.**</th>
<th>P</th>
<th>OR</th>
<th>CI 95%</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Female gender</strong></td>
<td>0.252</td>
<td>0.355</td>
<td>0.48</td>
<td>1.3</td>
<td>0.6-2.6</td>
</tr>
<tr>
<td>Dentist as a parent</td>
<td>-1.014</td>
<td>0.791</td>
<td>0.20</td>
<td>0.4</td>
<td>0.1-1.7</td>
</tr>
<tr>
<td>Dental hygienist background</td>
<td>-0.218</td>
<td>0.579</td>
<td>0.71</td>
<td>0.8</td>
<td>0.3-2.5</td>
</tr>
<tr>
<td>Fulfilled criteria for recommended OSC</td>
<td></td>
<td></td>
<td></td>
<td>1.9</td>
<td>1.0-3.6</td>
</tr>
<tr>
<td>Highest scores of preventive knowledge (quartile 4)</td>
<td>-0.039</td>
<td>0.476</td>
<td>0.94</td>
<td>1.0</td>
<td>0.4-2.5</td>
</tr>
<tr>
<td>Highest scores of attitude towards prevention (quartile 4)</td>
<td>0.596</td>
<td>0.312</td>
<td>0.06</td>
<td>1.8</td>
<td>1.0-3.4</td>
</tr>
<tr>
<td>More competency in giving preventive care</td>
<td>0.677</td>
<td>0.335</td>
<td>0.04</td>
<td>2.0</td>
<td>1.0-3.8</td>
</tr>
<tr>
<td><strong>Constant</strong></td>
<td>-3.397</td>
<td>1.386</td>
<td>0.02</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Hosmer-Lemeshow goodness-of-fit test significance P>0.05 for the model.
* Estimate of Strength
** Standard Error
5.4. What are the main study motives and career preferences among the dental students? (V)

5.4.1. Motives to study dentistry among the students

Regarding the motives to study dentistry, "Social status of being a dentist" and "personal interest in dentistry", with the mean scores of 4.0 (SD=1.2) and 3.8 (SD=1.5) respectively, received the highest rankings by the students. With a mean score of 0.3 (SD=0.9), "Failing to be admitted to other programmes" was identified as the least influential motive.

Factor analysis resulted in five factors that explained 73% of the total variance (Table 5.8). Based on the computed sum variables for these factors, five motive dimensions were identified: 1. Altruism and intellectual challenges, 2. Nature of the profession, 3. Social status and security, 4. Other person’s recommendation, and 5. Failure to be admitted to other programmes.

By using the sum variables to identify the proportion of the students who had each dimension as their highest ranked motive (Table 5.9) it was found that the students with a dental hygienist background were more likely to have "Altruism and intellectual challenges" as their first-ranked motive (P=0.003).

5.4.2. Career preferences among the students

As it shown in Table 5.10, entering postgraduate courses was the first career preference of 70% of the respondents (75% of women and 63% of men, P=0.03). Compared to women, a higher proportion of men preferred to be employed (13% vs. 7%, P=0.01). Men with a dental hygienist background were more likely to be employed (P=0.001) and to enter community oral health and research field (P=0.003), but less likely to enter postgraduate courses (P<0.001).

The students who ranked "Altruism and intellectual challenges" as their first motive were more likely to enter "Community oral health and research" after graduation (P=0.001).
Table 5.8. Factor loadings* on study motives amongst Iranian senior dental students (n=270).

<table>
<thead>
<tr>
<th>Factor</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>Helping people to improve their health</td>
<td>0.806</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Playing a role in community health promotion</td>
<td>0.844</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Being a researcher in the field of dentistry</td>
<td>0.790</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Personal interest in dentistry</td>
<td>0.772</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Interest in working with one’s hands</td>
<td>0.878</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Existence of artistic theme in dentistry</td>
<td>0.827</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>High income from practicing dentistry</td>
<td>0.825</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Ability to be self-employed</td>
<td>0.611</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Social status of being a dentist</td>
<td>0.804</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Parents’ recommendation</td>
<td>0.804</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Friends’ or relatives’ recommendation</td>
<td>0.818</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Failure to be admitted to other programmes</td>
<td>0.989</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

*Factor loadings less than 0.4 not shown

Table 5.9. Distribution of the Iranian senior dental students (n=270) according to their top-ranked motive to study dentistry and their background factors.

<table>
<thead>
<tr>
<th>Gender</th>
<th>Parent employed as a dentist</th>
<th>Dental hygienist background</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men %</td>
<td>Women %</td>
</tr>
<tr>
<td>All</td>
<td>39</td>
<td>41</td>
</tr>
<tr>
<td>Men</td>
<td>38</td>
<td>40</td>
</tr>
<tr>
<td>Women</td>
<td>41</td>
<td>37</td>
</tr>
<tr>
<td>P *</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Since "Failure to be admitted to other programmes" was the top-ranked motive of only 1% of the respondents, it was excluded here.

*Chi-square test was used to evaluate statistical differences based on gender, whether or not at least one parent was employed in dentistry and whether students had or did not have a background in dental hygiene.

** Since only one female student had a dental hygienist background, percentages in these two columns are for male students only.
Table 5.10. Distribution of the Iranian senior dental students (n=270) according to their career preferences and their background factors.

<table>
<thead>
<tr>
<th>Higher education as the career preference</th>
<th>Gender</th>
<th>Parent employed as a dentist</th>
<th>Dental hygienist background</th>
</tr>
</thead>
<tbody>
<tr>
<td>All %</td>
<td>Men %</td>
<td>Women %</td>
<td>P*</td>
</tr>
<tr>
<td>70</td>
<td>63</td>
<td>75</td>
<td>0.03</td>
</tr>
<tr>
<td>13</td>
<td>13</td>
<td>13</td>
<td>0.9</td>
</tr>
<tr>
<td>9</td>
<td>13</td>
<td>7</td>
<td>0.01</td>
</tr>
<tr>
<td>8</td>
<td>11</td>
<td>7</td>
<td>0.24</td>
</tr>
</tbody>
</table>

*Chi-square test was used to evaluate statistical differences based on gender, whether or not at least one parent was employed in dentistry and whether students had or did not have a background in dental hygiene.

** Since only one female student had a dental hygienist background, percentages in these two columns are for male students only.
6. Discussion

The present study assessed the status of preventive dentistry in the dental education system of Iran in terms of knowledge, attitudes and behaviours of dental school educators and dental students. The main results of this study can be summarized as follows.

The majority of the educators and the students were aware of the caries-preventive effects of limiting frequency of sugar intake, adding fluoride to drinking water, and applying fissure sealants. On the other hand, less than 15% of them believed that using fluoridated toothpaste was more beneficial than brushing *per se* for caries prevention. While preventive dentistry was characterized as “Useful for the community” and “Essential” by at least 80% of the respondents, less than half of them identified it as “Beneficial for the dentist” and “Prestigious”. Contrary to those of the students, the educators' knowledge and attitudes were associated with some of their academic and personal background characteristics.

The reported frequency of some of the OSC components, such as tooth brushing and using fluoridated toothpaste, was significantly different between the educators and the students. Fulfilling criteria for recommended OSC was associated with female gender and familiarity with the oral public health field among the educators, and with female gender and positive attitudes towards preventive dentistry among the students. Regarding the smoking habits of the educators, smoking was frequent among the educators, with 25% of the men reporting habitual cigarette or pipe smoking, while none of the women reported any kind of smoking.

Generally the students were favourably disposed to applying a risk-based approach in providing preventive care for their patients. Determinants of preventive practice among the students were their knowledge of prevention, their attitudes towards preventive dentistry, and their self-perceived competency in giving preventive care.

*Characteristics of the profession and social status and security* were the top-ranked motive dimensions to study dentistry among the students, and students mostly preferred to enter postgraduate courses and private practice after graduation.
6.1. Methodological aspects of the study

The target population of the study comprised all the dental educators and senior students in the 15 state dental schools in Iran. Although the educational curriculum in the private schools is the same as that in the state schools (Dental Education Programme, 2000), such differences as those related to a separate entrance examination and the students’ background (the expectation that they would pay for their educational expenses), was judged to reduce comparability. Thus the private schools were excluded.

Since the old and new state schools are different in some aspects, such as the amount of teaching experience of the educators (Mohammadi et al., 2004), stratification of the schools based on their age in the sampling process helped to obtain a more representative sample. This was further reinforced by selecting schools within the two strata randomly and by treating the selected schools as clusters. The relatively high response rates (80% for the educators and 82% for the students), supported by personal visits in the selected schools, speaks for the representativeness of the sample.

All of the participants of the study were oral health professionals. This homogeneity reduces the probability of biases related to misconceptions and errors (Heløe, 1972), and to non-responses and incorrect answers (Sjöström et al., 1999), which have been reported to exist in studies using self-administered questionnaires with lay populations. However, like any other questionnaire survey, the tendency among the participants to give favourable responses, which is referred to as social desirability (Sjöström & Holst, 2002), might have affected the responses. Although an effort was made to reduce this effect by assuring the participants that the returned questionnaires would be analyzed anonymously, the results may be an optimistic estimation of the real situation.

In order to increase the validity and reliability of the data, the contents of the designed questionnaires were revised based on discussions with five educators and ten students. The feasibility of the study method was also tested by conducting a pilot study prior to the main study in 2005 in one of the excluded schools.

In order to get accurate responses, an effort was made to provide a wide range of possible answers. This variation was obtained by implementing a five-point Likert scale for knowledge and practice questions; using a seven-point semantic differential scale to measure attitudes; offering several
alternatives for OHB questions; and applying a one-to-five scoring system for study motives and career choices.

Using a semantic differential scale has been reported to be a valid and reliable method of assessing the attitudes (Rosenberg et al., 1996). This well-known approach has been used in the field of dental education and dentistry research to measure attitudes of dental students towards dental public health as a career (Petterson, 1975), to assess the attitudes of male dental students and faculty members towards female dental students (Rosenberg et al., 1996; Rosenberg & Thompson, 1976), to evaluate the dental students' perception of a course in community dentistry (Giddon et al., 1976), and to measure satisfaction outcomes of endodontic treatments (Dugas et al., 2002).

Using hypothetical cases to assess the preventive practice of the students eliminated the effect of those barriers to the optimum use of preventive measures in dental practice that are related to work conditions. This helped to assess what the students had learnt regarding caries prevention during their undergraduate training. The dentists' practice in real life situations, however, should be further studied. With regard to the current emphasis on a risk-based approach in general practice, two separate cases, one high-risk and one low-risk, were presented to the students. The criteria used to define the high-risk patient were those that have been the most widely documented, i.e. presence of active caries and multiple restorations (Kidd & Nyvad, 2003; Bader et al., 2003; Anderson, 2002; NIH, 2001; ADA, 1995), and poor oral hygiene (Pitts, 2004; NIH, 2001; ADA, 1995). Based on recent evidence of the effectiveness of twice-a-day brushing with fluoridated toothpaste (Twetman et al., 2003; Pine et al., 2000; Chestnut et al., 1998) and the necessity of dietary counselling for high-risk patients (Kidd & Nyvad, 2003), these items were used to define acceptable preventive practice.

To assess study motives, a primary tool based on previous studies (Scarbecz & Ross, 2002; Hallissey et al., 2000) was developed. Through discussions with the participants of the pilot study the tool was revised and shortened to the 12-item tool used here, which, according to the results of factor analysis, worked well.

The statistical differences between the subgroups were mostly evaluated by chi-square test, which is suitable for the comparison of frequencies in such cases (Bulman & Osborn, 1989). Fitting logistic regression models to the data provided the opportunity to assess the strength of each factor per se while controlling for the effects of the other factors in the models (Bulman & Osborn, 1989).
study motives were primarily analyzed by factor analysis, which provided additional insight into the basic dimensions of study motives and provided a better understanding of central themes of dental students' thinking about their profession (Scarbecz & Ross, 2002).

6.2. Results of the study

6.2.1. Knowledge and attitudes towards prevention among educators and students

Generally, a relatively high level of consistency existed between the educators and the students regarding their knowledge and attitudes towards prevention. This finding highlights the role of educators in shaping the orientation of the students, either directly via usual training, or indirectly through a hidden curriculum (Brown et al., 2002). Similar to Swedish graduates (Petterson, 1979), but contrary to Mongolian dentists and dental students (Tseveenjav, 2004), most of the educators and the students in this study were aware of the caries-preventive effect of adding fluoride to drinking water and of applying fissure sealants. Despite this promising finding, a minority of our respondents appreciated the superiority of using fluoridated toothpaste over brushing *per se*, which is in line with reports for Mongolian dental students (Tseveenjav, 2004). With regard to the current emphasis on the important role of fluoridated toothpaste in caries prevention (Twetman et al., 2003; Marinho et al., 2003b; Bratthall, et al., 1996), it is clear that dental school curricula should pay more attention to this aspect.

While most of the respondents characterized preventive dentistry as "essential" and "useful for the community", less than half of them believed that it is "prestigious" or "beneficial for the dentist". This finding, which is consistent with findings among British dentists (Holloway & Clarkson, 1994), can be attributed to some of the barriers perceived by dentists to applying preventive measures, such as inadequate reimbursement for prevention (Pine et al., 2004), time limitations due to the great demand for curative care (Tseveenjav et al., 2005), and perceived unwillingness of patients to pay for prevention (Tomlinson & Treasure, 2006).

The educators working in departments of Pedodontics, Operative Dentistry or Periodontology had more extensive knowledge on prevention compared to educators in other departments. Those who were familiar with the field of OPH also reported more positive attitudes towards preventive dentistry. Since most of the topics related to preventive dentistry are currently taught in these departments.
departments (Dental Education Programme, 2000), this is not surprising. A previous study in Finland also showed that the educators differed in their diagnoses of carious lesions based on departments in which they taught (Rytömaa et al., 1979). This finding is also in line with the findings for faculty members in Denmark, where the educators of the department of Periodontics had the lowest plaque and gingival index scores compared to other educators (Lang et al., 1977). The fact that educators have various specialties, however, should not be used as an excuse for a lack of essential and basic knowledge of caries prevention. Thus, this variation among the educators may be reflected negatively in their own practice and in that of their students.

The failure to find almost any gender difference in the educators’ and students’ knowledge of prevention is in line with findings for Mongolian dentists and dental students (Tseveenjav, 2004). However, female educators reported more positive attitudes towards prevention compared to men. This difference can be attributed to background differences between the two genders, as well as to the more conservative style of dental practice among women as compared to men (Tan et al., 2002).

6.2.2. Oral health behaviour among educators and students

Sufficient evidence exists in the literature to consider twice-a-day brushing (Pine et al., 2000, Chestnut et al., 1998) with fluoridated toothpaste (Twetman et al., 2003; Marinho et al., 2003b) as recommended OSC. Reported frequencies of twice-a-day brushing (less than 70%) and regular use of fluoridated toothpaste (less than 80%) among the respondents were comparable to those of Mongolian dentists (81% and 62%, respectively) (Tseveenjav et al., 2004), but less than those of Mongolian dental students (96% and 85%, respectively) (Tseveenjav et al., 2003). Moreover, more than 50% of the respondents gave responses that indicated a failure to meet criteria for recommended OSC. Since oral health professionals are responsible for transmitting the latest scientific evidence regarding OSC measures to the public, they should practice them themselves. This, as the finding of this study show, seems to require more emphasis on the current concept of OSC in the dental schools.

The responses of Iranian educators and students reached significant gender difference in fulfilling criteria for recommended OSC in favour of women. While such a difference has been reported to exist in the lay population (Tada et al., 2004; Östberg et al., 1999), as well as in dental students at all stages (Al-Omari & Hamasha, 2005; Almas et al., 2003), previous findings from dentists (Tseveenjav et al., 2004) and senior dental students (Tseveenjav et al., 2002) have not shown a similar pattern. The notion that professional education overcomes the effects of such background
factors as gender (Tseveenjav, 2004) was not borne out among the participants in this study. This shows the effect of cross-cultural differences on OHB (Kawamura et al., 2005; 2001; 2000). This difference may be a reflection of the more positive attitudes towards prevention among women compared to men. Regardless of the reason, however, sufficient emphasis on prevention in the dental education system may reduce these differences.

Fulfilment of the criteria for recommended OSC was associated with more positive attitudes among the students, and with familiarity with the OPH field among the educators. The latter, being correlated with positive attitudes towards prevention, can be considered as a reflection of attitudes. These findings support the conception that the relationship between knowledge, attitude and practice is probably stronger among professionals than in the lay population (Frank et al., 2004; Tseveenjav et al., 2004).

A growing body of evidence exists in the literature regarding the important role of dentists and other oral health professionals in smoking cessation counselling (Johnson et al., 2006, Garg & Tandon, 2006; Petersen, 2003b; Tomar, 2001). Despite their professional training, the prevalence of cigarette smoking among male educators (22%) was similar to findings from their population counterparts (26%) (Ahmadi et al., 2001b), and greater than that reported by Iranian medical school educators (7.5%) (Ahmadi et al., 2001a). This finding is not in line with the results of a population-based study showing a greater decline in smoking among tertiary-educated people compared to their less-educated counterparts over a 15-year period (Giskes et al., 2005). It may also detract from the effort that should be made in the dental schools to train a dental workforce with required competencies in smoking cessation activities (Tomar, 2001). However, the finding that none of the women reported any kind of smoking may be helpful in this regard.

6.2.3. Prevention-oriented practice of students

The results of the study on preventive practice of students showed that the students were generally able to apply a risk-based approach in designing treatment plans for the two hypothetical cases. Their main emphasis, however, was on oral hygiene aspects of caries prevention leading to underestimation of the effectiveness of home use or chair-side application of fluoride even for the high-risk case. The same trend has also been reported for Korean (Moon et al., 1998) and Mongolian (Tseveenjav, 2004) dentists, and for dental hygienists in the United States (Forrest et al., 2000), while Finnish dentists have recognized home use of supplementary fluoride as an effective preventive measure (Vehkalahti & Widström, 2004). Such a conception among the students, which
may be due to overemphasis on the traditional preventive measures in the curriculum, is not in accordance with the current concepts of caries prevention, which include application of fluoride treatments according to the needs of patients instead of according to their ages (Barber & Wilkins, 2002), and the controversy over the effectiveness of flossing (Halla-Junior & Opperman, 2004; Sharma et al., 2002).

Better preventive practice among the students, in terms of both the practice scores and the criteria for acceptable practice, was associated with fulfilling the criteria for recommended OSC. This finding is not surprising, as a well-documented link between physicians’ personal health habits and their treatment practice has been reported previously (Frank et al., 2004). It also supports the idea that current behaviour can be predicted by previous behaviour (Brown et al., 2002). Students’ attitudes towards prevention and, to some extent, their preventive knowledge also appeared to influence their preventive practice. As expected, and previously reported for Mongolian dental students (Tseveenjav et al., 2003; 2002), self-perceived competency in giving preventive care was another influential factor with respect to the students' practice. These findings are consistent with the models and theories considering knowledge and attitudes as predispositions to act (Brown et al., 2002; Inglehart & Tedesco, 2000). They also show that training a prevention-oriented workforce in dental schools requires a definition of educational objectives in the three domains of cognitive, affective and psychomotor.

6.2.4. Study motives and career preferences among the students

The finding that a majority of the students had "Characteristics of the profession" and "Social status and security" dimension as their top-ranked motives is in line with the results of previous studies (Marino et al., 2006; Jover et al., 2006; Crossley & Mubarik, 2002; Hallissey et al., 2000). Only 17% of the students had altruism and intellectual challenges as their first motive dimension. This, together with the finding that entering community oral health and research field was the first career preference of only 8% of the students, supports the idea that a desire to serve the public is not among the most important motivations for entering dental school (Crossley & Mubarik, 2002). As it has been emphasized earlier (Sanders & Ferrillo, 2003; Crossley & Mubarik, 2002; Kerosuo et al., 2001), however, the dental education system should aim at creating social responsibility in its students.
The majority of the students preferred to continue their education towards a specialty degree. Existence of this tendency among the students is consistent with the results from British graduates (Stewart et al., 2005) and has certain implications for workforce planning (in the country).

Men and women were not found to differ in their study motives. Men's less inclination to enter postgraduate courses compared to women, as well as their greater tendency to be employed probably stems from the fact that all of the students with a dental hygienist background were men (with such differences compared to other men). Thus, it can be concluded that no major gender differences existed in the students' study motives and career preferences. This finding, which is in line with the results of one previous study (Hallissey et al., 2000) but of variance with those of some others (Bernabe et al., 2006; Stewart & Drummond, 2004; Scarbecz & Ross, 2002; Butters & Winter, 1999; Winter & Butters, 1998), reflects the effect of cross-cultural and background differences between societies and countries.

The role of dental hygienists in primary health care systems to promote oral health of the community has been recognized (Monajem, 2006; Ohrn, 2004). In the present study also, the students with dental hygienist background were more likely to rank "Altruism and intellectual challenges" as their first motive, and to enter community oral health and research field as their first career preference. In Iran, dental hygienists, who have been trained for two to three years, gain admission to study dentistry through an entrance exam after six years working in the primary health care system (Pakshir, 2003). It seems that their academic education in prevention, together with six years of employment in the primary health care system has had positive effects on their understanding and social responsibility. Based on these results, training an intermediary dental staff should be given high priority in workforce planning.

The finding that the students with "Altruism and intellectual challenges" as their first motive were more likely to enter community oral health and research field as their first career preference shows the importance of recruitment criteria in building a socially responsible dental workforce. Since short-term changes in the recruitment system in Iran seem unlikely, it remains the responsibility of dental schools to put sufficient emphasis on developing the relevant competencies.
7. Conclusions

1. In order to act as a role model for the public, dental educators and their students need to improve their own OHB.

2. Since preventive knowledge of dental educators and their students, as well as their attitudes towards preventive dentistry were positively correlated with their implementation of preventive measures for themselves and their patients, improvements in their knowledge and attitudes will be beneficial to the oral health of the community.

3. The current emphasis on developing the competency of smoking cessation counselling among dental students places greater responsibility on dental educators to give up their own smoking habits. The finding that none of the women reported any kind of smoking is encouraging in this regard.

4. The students’ predetermined beliefs play a major role in shaping their career preferences. In order to do justice to the current concepts of health care, more value should be placed on developing social responsibility among dental students in Iranian dental schools.

8. Recommendations

1. For the next revision of the dental education curriculum in Iran, sufficient emphasis should be placed on evidence-based preventive dentistry. Preventive aspects should be included in all disciplines in the revised curriculum.

2. Prevention-related topics in the current curriculum should be highlighted.

3. Continuing education programmes with prevention-related topics should be emphasized to provide dentists and dental educators with the opportunity of life-long learning.

4. By placing more emphasis on the behavioural sciences and community-based education, social responsibility and cultural competence among the dental students should be encouraged.

5. In order to improve the quality of dental education in Iran, new educational methods and curriculum designs, such as problem-based learning, competency-based education, and the comprehensive care model, should be implemented in Iran’s dental schools.

6. Congresses and seminars on various aspects of preventive dentistry should be conducted to present and discuss the latest concepts and theories.

7. In order to reinforce these recommendations, the following policies at administrative level are also suggested: 1) removal of the health-care system barriers to optimum implementation of preventive measures (e.g. insufficient reimbursement), 2) establishment
of educational programmes to train intermediary dental personnel such as dental hygienists, and 3) conducting interventions at the community level to increase public awareness of the importance and effectiveness of measures to prevent oral diseases (e.g. through mass media advertisements).
9. Summary

Although Iran lies in the category of countries with intermediate levels of caries prevalence according to dmft and DMFT values among various age groups, the high numbers of decayed teeth in the Iranian population is alarming. The ineffectiveness of curative approaches in promoting community oral health indicates the importance of implementing preventive strategies at an optimum level, which, in turn, requires the active presence of a prevention-oriented dental workforce.

The present study assessed the status of preventive dentistry in the dental education system in Iran in terms of knowledge, attitudes and behaviours among dental school educators and dental students. The working hypothesis was that wider implementation of preventive strategies by the oral health professionals, either for themselves or for their patients, is determined by their background factors, their knowledge of prevention, their attitudes towards preventive dentistry, and their competency in giving preventive care.

A representative sample of dental school educators and senior dental students was obtained by a multi-stage approach. First, all state dental schools in the country (n=15) were classified into two groups based on their years of operation, and two strata were defined accordingly. Second, three of the older schools and four of the newer schools were selected randomly to serve as clusters. Third, all of the educators and senior dental students of the selected dental schools were asked to participate in the study. The researcher visited the selected schools and delivered the questionnaire to the educators one by one and asked them to voluntarily fill in it. The students were asked to fill in the questionnaire in their ordinary classroom settings. Totally, 291 educators (80%) and 270 students (82%) participated in the study.

Two questionnaires for dental school educators and senior dental students were designed and piloted. In addition to some common items in both questionnaires such as OHB, knowledge of prevention, and attitude towards preventive dentistry, specific questions were included for each group. The educators were asked to state their highest academic degree, discipline of specialty, working experience as a teacher, and their familiarity with the Oral Public Health field. Questions about parent’s employment in dentistry, dental hygienist background, self-perceived competency in giving preventive care, study motivations, and career choices were specific items in the students’ questionnaire. To assess the preventive practice of the dental students, questions about two
hypothetical cases, one involving a high-risk patient and one involving a low risk patient, were also included in the students’ questionnaire. The students were asked to react to nine treatment alternatives given for both patients’ treatment plans on a five-point Likert scale ranging from “completely agree” to “completely disagree”.

The results showed that a majority of the educators and the students were aware of the caries-preventive effects of limiting frequency of sugar intake, adding fluoride to the drinking water, and applying fissure sealants, was found. However, less than 15% of the respondents believed in the greater benefits of using fluoridated toothpaste in caries prevention compared to brushing *per se*. Preventive dentistry was characterized as “Useful for the community” and “Essential” by more than 80% of the respondents, but less than 40% of them identified it as “Beneficial for the dentist” and “Prestigious”. Contrary to those of the students, the educators' knowledge and attitudes were associated with some of their academic and personal background characteristics.

Reported frequencies of twice-a-day brushing and use fluoridated toothpaste among both the educators and the students were not as high as those expected from oral health professionals. Fulfilling criteria for ‘recommended OSC’ was associated with female gender and familiarity with oral public health field among the educators, and with female gender and positive attitudes towards preventive dentistry among the students. Regarding the smoking habits of the educators, while none of the women reported any kind of smoking, 25% of the men reported habitual cigarette or pipe smoking.

Generally the students were able to apply a risk-based approach in designing treatment plans for the two cases. Determinants of preventive practice among the students were their knowledge of prevention, their attitudes towards preventive dentistry, and their self-perceived competency in giving preventive care.

*Characteristics of the profession* and *Social status and security* were the top-ranked motive dimensions to study dentistry among the students, and most students preferred to enter postgraduate courses and private practice after graduation.

It can be concluded that there is room to improve preventive orientation of the educators and the students through putting more value on prevention in the dental education system. Revising curriculum with the aim of integrating evidence-based prevention-related concepts to all disciplines,
highlighting prevention-related topics in the current curriculum, and providing the practicing dentists with the opportunity to attend continuing education courses on prevention will be helpful in this regard.
10. Acknowledgements

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Mohammad Reza Khami
Helsinki
May 2007
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To the participants in this study;

Thank you in advance for participating in this study.

The aim of this questionnaire survey is to provide baseline data necessary for improving the dental education system in Iran. The results of this study will ultimately help to promote the oral health of our community. Your thorough answers to these questions would be very helpful in this regard.

The questionnaire consists of various parts. Instructions to answer to the questions have been presented at the beginning of each section.

It is not necessary to write down your name. The completed questionnaires will be analyzed anonymously and no conclusions will be made based on individual responses.

If you have any questions or comments regarding the questions, please contact the researcher at the address below.

Thank you again for completing the questionnaire.

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Community Oral Health Department,
School of Dentistry,
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Tehran
Tel: 021-22421813
Email: mohammad.khami@helsinki.fi

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1 Combined version of the questionnaires for dental school educators and dental students in the appendix of this thesis.
1. Background information (for dental school educators)

1.1. Gender                           1. Male               2. Female
1.2. Year of birth ……..

1.3. What is your last academic degree? (If you have more than one specialty
degree, please indicate them.)
   1. D.D.S (general dentistry)
   2. M.S in ……..
   3. PhD in ……..

1.4. How many years have you taught in dental schools?………….years
1.5. In which department of the dental school do you currently work? Department
of……………………………

2. Background information (for dental students)

2.1. Gender:                             1. Male             2. Female
2.2. Year of birth……..
2.3. Is (or has been) one of your parents (or both of them) a dentist?
   1. Yes         2. No
2.4. Were you a dental hygienist before studying dentistry?
   1. Yes 2. No

3. Familiarity with the Oral Public Health field (for dental school educators)

3.1. How acquainted are you with the “Oral Public Health” field?
   1. Very much
   2. Quite a bit
   3. A little
   4. Not at all
   5. Don’t know

3.2. Do you have any experience in the field of “Oral Public Health” (teaching,
doing research or working)?
   1. Very much
   2. Quite a bit
   3. A little
   4. Not at all
   5. Don’t know

4. Knowledge of caries prevention (for dental school educators and dental
students)

Please describe your opinion of the following statements by choosing one of the
following alternatives.

4.1. Fluoridation of drinking water is an effective, safe, and efficient way to
prevent dental caries.
   1. Strongly agree
   2. Agree
   3. Disagree
   4. Strongly disagree
   5. Don’t know

4.2. The frequency of sugar consumption has a greater role in producing caries
than does the total amount of sugar consumed.
   1. Strongly agree
   2. Agree
   3. Disagree
   4. Strongly disagree
   5. Don’t know

4.3. Sealant is effective in the prevention of pit and fissure caries in newly erupted
molars.
   1. Strongly agree
   2. Agree
   3. Disagree
   4. Strongly disagree
   5. Don’t know

4.4. Compared to a sound tooth, the probability of losing a restored tooth is
greater.
   1. Strongly agree
   2. Agree
   3. Disagree
   4. Strongly disagree
   5. Don’t know
4.5. Rinsing teeth with a lower amount of water after tooth-brushing increases the effect of fluoride.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree
5. Don’t know

4.6. Examining a newly erupted tooth with a sharp explorer damages the enamel rods and makes the tooth vulnerable to caries.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree
5. Don’t know

4.7. A white- or brown-spot lesion that is visible on a wet tooth surface has penetrated all the way through the enamel.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree
5. Don’t know

4.8. Using fluoride toothpaste is more important than the brushing per se for preventing caries.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree
5. Don’t know

4.9. Having dental problems can lead to general health problems.

1. Strongly agree
2. Agree
3. Disagree
4. Strongly disagree
5. Don’t know

5. Attitudes towards preventive dentistry (for dental school educators and dental students)

Please describe your opinion of preventive dentistry (in general) on the following scale of 5 qualities and their opposites. For example, if you think preventive dentistry is completely beneficial, circle number 7 and if you think it is completely costly, circle number 1. Otherwise, circle an appropriate medial number.

Costly for the dentist 1…2…3…4…5…6…7 Beneficial to the dentist
Useless for the community 1…2…3…4…5…6…7 Useful for the community
Non-Prestigious 1…2…3…4…5…6…7 Prestigious
Non-essential 1…2…3…4…5…6…7 Essential
Difficult 1…2…3…4…5…6…7 Simple

6. Oral health behaviour (for dental school educators and dental students)

In the following questions, please choose the appropriate alternative.
6.1. How often do you usually brush your teeth?
   1. Irregularly or never
   2. Once a week
   3. A few (2-3) times a week
   4. Once a day
   5. More than once a day

6.2. Do you use toothpaste containing fluoride when brushing?
   1. Always or almost always
   2. Quiet often
   3. Seldom
   4. Not at all

6.3. How often do you floss your teeth?
   1. Not at all
   2. Occasionally
   3. A few (2-3) times a week
   4. Once in a day
   5. More than once time in a day
6.4. How often do you eat sugar-containing snacks or drinks between your main meals?
1. About 3 times a day or more
2. About twice a day
3. About once a day
4. Occasionally; not every day
5. Rarely or never eat between meals

6.5. What do you do for your dental check-ups?
1. I go to a dentist to do that.
2. I ask my classmates (or colleagues) to do that.
3. I do it myself.
4. There is no need to attend dental check-ups.

6.6. When was your last dental check-up?
1. Within the last 6 months
2. More than 6 months to one year ago
3. More than 1 to 2 years ago
4. More than 2 to 5 years ago
5. More than 5 years ago
6. Never
7. Do not remember

6.7. Do you smoke cigarettes? (for dental school educator)
1. No, never
2. No, I used to, but I quit.
3. Yes, once a month or less
4. Yes, a few times (2-3) a month
5. Yes, a few times (2-3) a week
6. Yes, once a day or more

6.8. Do you smoke a pipe? (for dental school educator)
1. No, never
2. No, I used to, but I quit.
3. Yes, once a month or less
4. Yes, a few times (2-3) a month
5. Yes, a few times (2-3) a week
6. Yes, once a day or more

7. Prevention-oriented practice (for dental students)
In each of the following cases, describe your opinion about including any of the following alternatives in the treatment plan of the patients in order to conduct the best preventive protocol for the patient. Mark only one number in each choice.

7.1. Patient 1: 18-year-old boy with no systemic or mental problems. Teeth #13, 14, 20 and 30 (universal teeth numbering) were filled last year and teeth #3, 4 and 21 have dentinal caries (as it can be seen in radiographs). Plaque can be found on the surface of the teeth. His chief complaint is transient pain in #21 tooth when drinking cold water. He says that he does not brush regularly.

<table>
<thead>
<tr>
<th>Strongly Disagree</th>
<th>No Opinion</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1</td>
<td>2</td>
</tr>
</tbody>
</table>

7.1.1. Filling teeth #3, 4 and consideration of root canal therapy for #21
1. 2 | 3 | 4 | 5 | 6 |

7.1.2. Oral health instructions about the importance and proper way and time of brushing
1. 2 | 3 | 4 | 5 | 6 |

7.1.3. Advice on using fluoridated toothpaste
1. 2 | 3 | 4 | 5 | 6 |

7.1.4. Recommending use of fluoridated toothpaste
1. 2 | 3 | 4 | 5 | 6 |

7.1.5. Instructing in home use of NaF 0.2% mouth wash once a week
1. 2 | 3 | 4 | 5 | 6 |

7.1.6. Applying chairside fluoride gel twice a year
1. 2 | 3 | 4 | 5 | 6 |

7.1.7. Professional cleaning of teeth (prophylaxy)
1. 2 | 3 | 4 | 5 | 6 |

7.1.8. Dietary counselling
1. 2 | 3 | 4 | 5 | 6 |

7.1.9. Adjusting check-up intervals at 3-6 months
1. 2 | 3 | 4 | 5 | 6 |
7.2. Patient 2: 22-year-old girl with no systemic or mental problems. She has a filled tooth (#19), which was filled 5 years ago, and a decayed tooth (#20). There is no evidence of any other caries in radiographs and an examination. She is a medical student who says that she brushes regularly. Her chief complaint is "having a decayed tooth" (#20).

<table>
<thead>
<tr>
<th>7.2.1. Filling tooth #20</th>
<th>Strongly Disagree</th>
<th>No Opinion</th>
<th>Strongly Agree</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
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</table>

| 7.2.2. Oral health instructions about the importance and proper way and time of brushing | 1 2 3 4 5 |
| 7.2.3. Advice on using fluoridated toothpaste | 1 2 3 4 5 |
| 7.2.4. Recommending use of fluoridated toothpaste | 1 2 3 4 5 |
| 7.2.5. Instructing in home use of NaF 0.2% mouth wash once a week | 1 2 3 4 5 |
| 7.2.6. Applying chairside fluoride gel twice a year | 1 2 3 4 5 |
| 7.2.7. Professional cleaning of teeth (prophylaxy) | 1 2 3 4 5 |
| 7.2.8. Dietary counselling | 1 2 3 4 5 |
| 7.2.9. Adjusting check-up intervals at 9-12 months | 1 2 3 4 5 |

8. Self-perceived competency in provision of preventive care (for dental students)

How competent do you feel to do the following?

8.1. Give oral hygiene instructions to the patients.
   1. Very competent
   2. Quite competent
   3. Not very competent
   4. Not at all competent
   5. I have never done that

8.2. Give dietary counselling to the patients.
   1. Very competent
   2. Quite competent
   3. Not very competent
   4. Not at all competent
   5. I have never done that

8.3. Apply topical fluoride (gel, varnish, mouth rinse).
   1. Very competent

2. Quite competent
3. Not very competent
4. Not at all competent
5. I have never done that

8.4. Perform fissure sealant therapy on children.
   1. Very competent
   2. Quite competent
   3. Not very competent
   4. Not at all competent
   5. I have never done that

8.5. Give preventive care to high-risk patients.
   1. Very competent
   2. Quite competent
   3. Not very competent
   4. Not at all competent
   5. I have never done that

9. Motives to study dentistry and career preference after graduation (for dental students)

9.1. The following factors may have positively influenced your decision to study dentistry. Give a score from 0 to 5 to each of the factors, where 0 represents a factor that had no influence on your decision and 10 represents a very influential factor (two or more alternatives can have same scores). If you think there are some other alternatives, please write them down and give their scores.

| 9.1.1 Failure to be admitted to other programmes | 0 1 2 3 4 5 |
| 9.1.2 Parents' recommendation | 0 1 2 3 4 5 |
| 9.1.3 Friends' or relatives' recommendation | 0 1 2 3 4 5 |
| 9.1.4 Personal interest in dentistry | 0 1 2 3 4 5 |
| 9.1.5 Interest in working with one's hands | 0 1 2 3 4 5 |
| 9.1.6 Existence of artistic theme in dentistry | 0 1 2 3 4 5 |
| 9.1.7 High income from practicing dentistry | 0 1 2 3 4 5 |
| 9.1.8 Ability to be self-employed | 0 1 2 3 4 5 |
| 9.1.9 Social status of being a dentist | 0 1 2 3 4 5 |
| 9.1.10 Helping people to improve their health | 0 1 2 3 4 5 |
| 9.1.11 Playing a role in community health promotion | 0 1 2 3 4 5 |
| 9.1.12 Being a researcher in the field of dentistry | 0 1 2 3 4 5 |
| 9.1.13 Other, specify… | 0 1 2 3 4 5 |
9.2. Please describe your willingness to work in each of the following fields after graduation by circling a number. Selecting 0 for an alternative means that you do not want to work in that field and 5 means you are very eager to work in it (two or more alternatives can have same scores). If you think there are some other alternatives, please write them down and give their scores.

<table>
<thead>
<tr>
<th>9.2.1. To be a solo practitioner in a private office</th>
<th>0</th>
<th>1</th>
<th>2</th>
<th>3</th>
<th>4</th>
<th>5</th>
</tr>
</thead>
<tbody>
<tr>
<td>9.2.2. To work in a clinic as an independent contractor</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.3. To be a shareholder in an incorporated practice</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.4. To be employed on salary or commission in a governmental organization</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.5. To be employed on salary or commission in a private organization</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.6. To work as a dentist in the primary health care system</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.7. To work or study in the field of oral public health</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.8. To be a researcher in dentistry</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.9. Entering a postgraduate programme</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
<tr>
<td>9.2.10. Other, specify…</td>
<td>0</td>
<td>1</td>
<td>2</td>
<td>3</td>
<td>4</td>
<td>5</td>
</tr>
</tbody>
</table>
13. Original publications

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