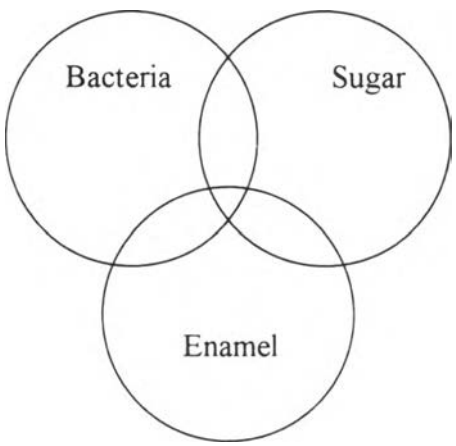
CHAPTER II

LITERATURE REVIEW

Dental caries is carious destruction of teeth. This disease is caused by the combination of a high number of bacteria, weakness of enamel of teeth and the fermentable carbohydrates derived from sugar (Figure 2.1). The bacteria in the plaque produce acids from food we eat, these acids attack the tooth enamel and cause caries. The bacteria grow and produce a lot of acid very quickly if they are supplied with sugar.

Figure 2.1: The Combination of Factors that Cause Dental Caries



Many years ago, the causes of dental caries were unknown. By the 1930s and 1940s epidemiological surveys showed a high prevalence of dental caries in North America, north western Europe, Australia, New Zealand while in less industrialized nations, in the developing countries and remote populations the prevalence of dental caries was still low but in many cases rising (WHO, 1994).

Advances in dental research have shown that all fermentable carbohydrates, including sugar, contribute to development of dental decay. Together with sugar, lower oral hygiene status and the weakness of enamel of teeth also contribute to the cause of dental caries. In the evaluation of dental status, DMFS (the mean of decayed, missing and filled teeth surfaces) is used. The lower the DFMS index, the better the dental status.

In the recent years, there has been a remarkable reduction of DMFS score of developed countries while the DFMS score is still increasing in developing countries (World Health Forum 15, 1994).

Primary Health Care is the strategy and long-term objective of WHO and Oral Health is an integral part of Primary Health Care. The global goals of WHO for dental caries at the end of this century (Health for all by the year 2000)were established as follows (WHO, 1994).

Table 2.1: The Global Goals of WHO for Dental Caries at the End of this Century

AGE	GOAL
1. 5-6 years	50% should be free of dental caries.
2. 12 years	3 or lower DMFS index
3. 18 years	80% should retain all their teeth
4. 35-44 years	A 50% reduction in 1981 level of edentulousness
5. 65 years and over	A 25% reduction in 1981 level of edentulousness.

The question is how to achieve the goal of WHO for Dental Health Care by the year 2000. The Primary Dental Health Care Programme was applied in all countries in the world with the aim to decrease the causes of dental caries and factors which contribute to the development of dental decay under guidelines and supervision of WHO This progamme is not only to prevent dental disease but also to contain the cost of health care. The basic idea is a simple one: relatively low cost investment in disease prevention and health promotion will prevent or postpone illness and disability that require more expensive medical care.

The World Health Organization has introduced many strategies to prevent dental caries

Firstly, fluoride was used to make enamel become better. Fluoride is deposited in calcified structures by the exchange of hydroxyl ion in the hydroxyapatite lattice with the fluoride ion to form the compound fluorohydroxylapatite. Together with depositing in the enamel via the systemic route when the lattice is developing and maturing, because mature adult tooth enamel has no cells, fluoride in the mouth penetrates the enamel surface by diffusion through the minute spaces between the enamel crystals With this mechanism fluoride inhibits caries by increasing the fluoride in the outer enamel surface and its ability to remineralize demineralized or hypomineralized enamel, and by fluoride's antibacterial

effects on plaque growth, glycolysis, glycogen synthesis, acid production, production of extracellular, polysaccharide necessary for plaque adhesion to tooth surface and solubility of calcium phosphate deposit within plaques (Jovanovich, Harcourt Brace, 1989).

Secondly, the improvement of dental hygiene can reduce the number of bacteria and remove the residual of food in the mouth.

Thirdly, modifying dietary habits also contribute to the prevention of dental caries.

Finally, visiting dentists regularly to get treatment earlier is also a way of preventing dental caries and its consequences.

Based on the ways for preventing dental caries, many strategies have been developed: water fluoridation strategy, improving dental hygiene strategy, dietary change strategy, school-based oral health, making better use of dental services (Akehurst and Sanderson, 1993).

2.1 Water Fluoridation

Among these strategies water fluoridation is a most cost-effective strategy. Water fluoridation is dentistry's greatest contribution to public health. At the community level, there is abundant evidence to show that fluoridation reduces the prevalence and incidence of caries more than any other preventive measure. It is generally accepted as the most cost-effective preventive measure in dentistry. It's also a socially equitable form of in that receipt of its benefit is not dependent on income, education, or access to dental treatment.

2.1.1 Community Water Fluoridation:

Beginning in the 1920's fluoridation was the subject of major public health investigations, which eventually set the optimal level of fluoride in the drinking water at around 1 part per million. This fluoride level was shown to produce a 60 to 70 percent reduction in caries from birth and cause no adverse health effect or mottled teeth (Kerr, 1981).

In United State a study lasting 10 years showed that the children in Newburgh who drank the artificially fluoridated water experienced 40-60 % less decay than the children of Kingston who drank the nonfluoridated water. These was reduced loss of teeth and reduced incidence of caries as well (Jovanovich, 1989).

In another study in United States school children who had always been exposed to community water fluoridation had mean DMFS scores approximately 18 % lower than those who had never lived in fluoridated community (Jong, 1988).

Several studies have highlighted the cost-effectiveness of water fluoridation in USA, in Australia and in UK (Akehurst and Sanderson, 1993). With this strategy in UK, there has been a 50% reduction of dental caries in the population that received fluoridated water at an average annual equivalent costs of 38 p per person. This would cost about 10.5 million Pounds per year and would result in a reduction of total DMFT by about 10 million over 14 years for children born post-flouridation (Akehurst and Sanderson, 1993).

Birch 1990 draws together figures from a number of studies to show the expected reductions in DMFT score at various ages. These studies suggested that fluoridated water would be expected to reduce caries by 50-60% for high risk children (e g. DMFT at 5 years from 3.3 to 1.3 and DMFT at 14 years from 5.0 to 2.3)and between 30-50% for medium and low risk children (e g. DMFT at 5 years for medium risk group from 2.0 to 1 0 and DMFT at 14 years for low risk group from 2.6 to 1.7).

The costs for running this strategy are lower than some other actions But the weakness of this strategy is that fluoridated water can't provide for the population that does not use a water supply system, such as populations in rural and remote areas

2.1.2 School Water Fluoridation :

In communities lacking a centralized water supply, school water fluoridation is an alternative mean The maximum reduction in caries rate is approximately 30-40% (Jovanovich, 1989).

In USA the population who live in areas that lack central water systems, school water supplies have been fluoridated with level of three times, 4 5 times, and seven times the optimum for communal water fluoridation; the caries reduction at each of these respective levels of fluoridation was 20, 40, 40% (Kerr, 1981).

In Seagrove, North Carolina, after 12 years of school water adjusted at 7 times optimum recommended fluoride level for that locale, the students had an average of 48% fewer DMF surfaces compared with their counterparts in the baseline examination made before the water was adjusted (Jong, 1988).

2.1.3 Fluoride Rinse

One way in which the topical benefits of fluoride may be attained is by mouthrinsing with fluoride-containing solution applied to cleaned and dried enamel surface. Many studies have shown that rinsing daily or weekly with a dilute solution of

fluoride reduces the incidence of dental caries by approximately 30% and from 20-50% in children. Fluoride mouthrinsing is one of the most widely used caries-preventive public health methods. It is second only to community water fluoridation (Jong, 1988).

Studies of fluoride mouthrising have given consistently positive results, with few reporting reduction lower than 20%. For the school-based method, using the 0.2 % sodium fluoride mouthrinse one a week, caries reduction in a fluoride deficient community ranged from 16 % to 44 % with an average of 31%. The cost of supplies to conduct a fluoride mouthrinse programme range from $ 0.69 to $ 1.22 per child per year (in 1988 dollars) (Jong, 1988). The cost/benefit ratio of a weekly fluoride mouthrinsing session is 1/10 or $ 1.00 for each tooth surface saved.

Another study showed that in Guam 1976 a school-based fluoride mouthrinse programme was initiated in the form of a weekly rinse with 0.2% neutral NaF After 8 years of fluoride mouthrinsing, mean DMFS scores were 1.79 surfaces per child lower compared to baseline, a decease of 0.22 DMFS per child per year (Steritt, 1990).

Besides being safe, economical and effective, fluoridation is beneficial in other ways. One important effect was identified by WHO in June 1970: by reducing the prevalence of dental caries it enable dental personnel to deal with a large number of patients.

According to Kerr's study in Germany after 8 years of water fluoridation the ratio of dentists required per child reduced from 1/1200 to 1/2700. In New Zealand 10 years of fluoridation the number of dental nurses needed to treat 3 to 14 year-olds decreased from 1/475 to 1/650 The actual costs of care per child are also reduced by fluoridation. An Illinois study estimated that children drinking fluoridated water had six less carious lesions per child than those drinking water at low levels of fluoridation (Kerr, 19981)

Similarly in Toronto fluoridated water cut costs in half, the Karl-Marx-Start study also conclude that fluoridation lowered the ratio of routine examinations to treatment session and therefore that the percent of carious teeth actually receiving restoration, once caries was detected, was higher in fluoridated communities (Kerr, 1981).

2.2 Improvement of Dental Hygiene

The combination between bad oral hygiene status and inappropriate diet in causing dental caries is known. To encourage the improvement of dental hygiene by brushing teeth regularly with fluoridated tooth paste and the correct technique, flossing after brushing, modifying dietary habits (e.g. reducing sugar consumption) also represent important strategies.

2.2.1 Teeth-brushing

According to Lawrence's study, a study by Horowitz and Thompson demonstrated that oral cleanliness did not significantly decrease the incidence of dental caries in school children. But Lindhe's famous studies in Sweden indicated quite the opposite results, however, children's teeth were brushed professionally in these studies. The use of a fluoridated tooth paste in plaque removal has consistently been shown to reduce dental caries (Kerr, 1981).

In the United Kingdom, it is estimated that an average of $15-$20 would have to be spent per person per year if the entire population were to undertake regular self-administrated oral hygiene and buy 4 new toothbrushes per year. However, the magnitude of the improvement cannot be identified. There is very little evidence about the effectiveness of campaigns in UK to improve oral hygiene (Akehurst and Sanderson, 1993).

2.2.2 Teeth-flossing

Flossing after brushing seems to have a clear effect on reducing caries in the approximate tooth surface. In a study in western Ontario, interdental flossing resulted in a significant reduction in the incidence of interproximal caries in a group 5-year-old children over a 20 month period (Kerr, 1981).

2.3 Changing Dietary Habit

An association between the scale and frequency of intake of sugar and the incidence of caries is known. Modifying dietary strategy also contributes to prevent dental disease. Sreebny reported an almost linear relationship with high coefficient of determination between average DMFT and average sucrose consumption per person per year in a cross-sectional study of 14 countries. According to Jong's study, Woodward and Walker have recently examined data on dental caries amongst 12 year old children and sugar consumption for 91 countries. They found for the whole data set that DMFT score does tend to raise with sugar consumption. However, more relevant to the UK is the fact that when the data for 28 industrialized nations were examined separately there was no evidence of sugar-caries relationship. Jong suggested that the full study by Woodward and Walker and the earlier Sreebny study might be picking up a relationship between caries prevalence and economic development, with sugar consumption in turn being correlated with the latter (Jong 1988)

2.4 The Pit and Fissure Sealant

Beside water fluoridation, the application of dental sealant is a highly effective means of preventing pit and fissure caries. It can be highly recommended for any Third World community where there is a high prevalence of occlusional caries, with little smooth surface caries, limited access to and use of dental care, and low social economic status (Yupin ,1994).

A study in Guam showed that after 2 years of fluoride mouthrinsing and sealant application combined overall DMFS scores decreased an additional 2.34 surfaces per child per year, a reduction of 1.17 DMFS per child per year. Most of this decline took place on pit and fissure surfaces. For a ten year period a reduction of 4.13 DMFS per child reflected a decline from 7.06 DMF at baseline to 2.93 DMFS per child in 1986. This long-term evaluation indicated that dental sealant when used in combination with fluoride mouthrinse was particularly effective in lowering the prevalence of dental caries (Steritt, 1990).

In the United States, based on a survey conducted by the American Dental Association, the general practitioners' average fee for sealant application was $13.73 per tooth. For pediatric dentists it was $15.90 (Jong, 1988). Cost for placement of sealant is approximately one-half that of placing amalgams and one-sixth if using auxiliaries (Kerr, 1981).

2.5 Visiting the Dentist Regularly

Encouragement to visit the dentist has been introduced not only in the school-based area but also in the mass media. These strategies also get good results in reducing prevalence of the disease.

2.6 School-based Oral Health Programme

To prevent dental caries for children is very necessary. The school-based oral health programme has been implemented in many countries. This programme is very useful not only for children in the developed countries but also for children in remote areas and developing countries such as Madagascar, Zimbabwe, Mali.etc. where children have almost no access to the care they need.

Even though this programme has been run for a long time, very few studies have evaluated it in terms of cost for running the programme and cost-effectiveness. Klein and others (1985) studied the cost-effectiveness of the school-based oral health programme in USA and concluded that it is not effective in reducing a substantial amount of dental decay. But some other researchers in UK (Akehurst and Sanderson, 1993) stated that these findings do not necessarily mean that a school-based oral health programme cannot

be cost-effective in UK. Cost and cost-effectiveness of this programme should therefore continue to be studied.

In Vietnam, Primary Dental Health Care was applied since 1976 in the South of Vietnam and since 1985 in the North of Vietnam by some strategies such as water flouridation and fluorided toothpaste, improvement of dental hygiene by mass media, school-based oral health, etc. Among these strategies, the school-based Oral Health Programme also has been implemented at kindergartens and primary schools but the cover of this programme is very low. Since this programme has been applied research was done to evaluate the pattern of this disease and it was found that in Ho Chi Minh City there is increasing prevalence and DMFT index of dental caries in the children especially the children at age 12 years : DMFT index was 2.38 in 1981, 3.27 in 1984 and 79% children at this age were suffering from dental disease.

In 1989 this index was increased to 3.4 and the prevalence of children suffering from this disease was 83.9%; it continues increasing even though slowly (Quang, 1990). In the North the DMFT index is lower than in the South. Some epidemiological surveys showed that the DMFT index and the prevalence of children suffering from dental caries have been increasing: 0.44 in 1983 to 1.15 in 1991 (Quang, 1991). The evaluation of the programme on the economic aspect has not yet been done.