Chapter II

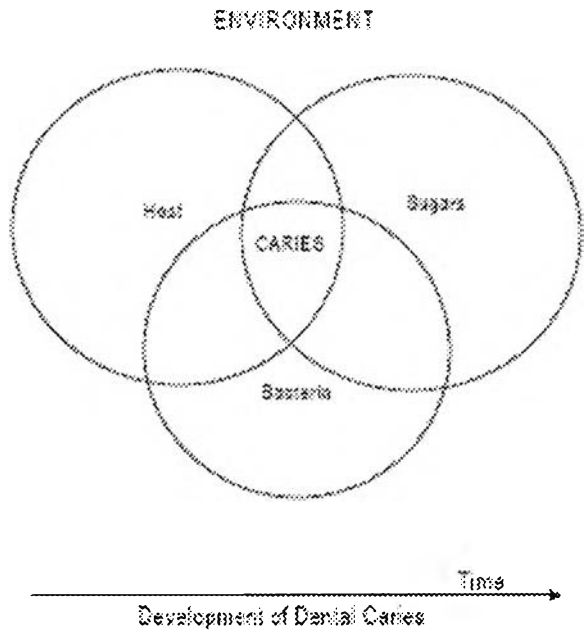
Literature Review

2.1 Etiology of Caries

Tooth decay is one of the most common of all disorders, second only to the common cold. It usually occurs in children and young adults but it can affect any person and it is the most important cause of tooth loss in younger people.

The development of dental caries is a process of infection that requires three simultaneous factors over time - a susceptible host, bacteria and sugars (see Figure 2.1). It is an infectious disease mediated by diet, hygiene and host resistance, the latter increasing with optimum intake of fluoride.

Figure 2.1: Etiologic factors of dental caries



Bacteria are normally present in the mouth. Mutans streptococci are considered to be important bacteria for dental caries development. The bacteria convert all foods especially sugar and starch into acids. Bacteria, acid, food debris, and saliva combine in the mouth to form a sticky substance called plaque that adheres to the teeth. It is most prominent on the posterior molars, just above the gum line on all teeth, and at the edges of fillings. In young children early visible plaque on the labial surfaces of the maxillary incisors is strongly associated with caries development (Alaluusua & Malvivirta 1994). Furthermore, dental caries reductions have been noted in children who receive high frequency professional prophylaxis combined with some form of fluoride therapy (Lindhe, Axelsson, & Tollskog 1975) or frequent tooth brushing with fluoridated dentifrice (Leske, Ripa, & Barenie 1976).

Plaque begins to accumulate on teeth within 20 minutes after eating (the time when most bacterial activity occurs). The acids in plaque dissolve the enamel surface of the tooth and create holes in the tooth (cavities). Cavities are usually painless until they grow very large inside the tooth and destroy the nerve and blood vessels in the tooth. If left untreated, a tooth abscess can develop. Untreated tooth decay also destroys the internal structures of the tooth (pulp) and ultimately causes the loss of the tooth.

Carbohydrates (sugars and starches) increase the risk of tooth decay. Sticky foods are more harmful than nonsticky foods because they remain on the surface of the teeth. Frequent snacking increases the time that acids are in contact with the surface of the tooth.

2.2 Definition of DMFT and dmft index

DMFT & dmft indices are used to measure the average level of dental caries of permanent and primary dentitions in a community. This index is defined by WHO (1997) as follow:

DMFT describe the amount - the prevalence - of dental caries in an individual. DMFT is means to numerically express the caries prevalence.

DMFT index is obtained by counting the number of decayed teeth (D), missing teeth (M) due to caries and filled (F) teeth (T) in the mouth per person.

DMFT score equals the sum of the average number of decayed teeth per person plus the average number of missing teeth due to caries per person plus the average number of filled teeth per person.

DMFT =DT +MT +FT

Where DT is the number of decayed permanent teeth per person
=total number of decayed teeth divided by total children that were examined
MT is the number of missing permanent teeth due to caries per person
=total number of missing teeth divided by total children that were examined

FT is the number of filled permanent teeth per person
=total number of filled teeth divided by total children that were examined

It is thus used to get an estimation illustrating how much the dentition until the day of examination has become affected by dental caries. It is either calculated for 28 (permanent) teeth, excluding teeth #18, 28, 38 and 48 (the "wisdom" teeth) or for 32 teeth. Thus:

- How many teeth have caries lesions (incipient caries not included)?
- How many teeth have been extracted?
- How many teeth have fillings or crowns?

The sum of the three figures forms the DMFT-value. For example: DMFT of 4+3+9=16 means that 4 teeth are decayed, 3 teeth are missing and 9 teeth have fillings. It also implies that 12 teeth are intact.

If a tooth has both a caries lesion and a filling it is calculated as D only. A DMFT of 28 (or 32, if "wisdom" teeth included) is maximum, meaning that all teeth are affected.

A more detailed index is DMF calculated per tooth surface, DMFS. Molars and premolars are considered having 5 surfaces, front teeth 4 surfaces. Again, a surface with both caries and filling is scored as D. Maximum value for DMFS comes to 128 for 28 teeth.

For the **primary dentition** consisting of maximum 20 teeth, the corresponding designations are "dmft" and the method to calculate this index is similar to permanent teeth.

dmft =dt +mt +ft

Where dt is the number of decayed primary teeth per person
=total number of decayed teeth divided by total children that were examined

mt is the number of missing primary teeth due to caries per person
=total number of missing teeth divided by total children that were examined

ft is the number of filled primary teeth per person
=total number of filled teeth divided by total children that were examined

2.3 The Simplified Debris Index (DI-S)

The Simplified Debris Index (Greene & Vermillion 1964) measures the amount of plaque, which is related to gingivitis and dental caries. DI-S index is suitably used in school-based oral health program because this index can be measured easily and fast. Teeth to be examined are teeth #16, 26 buccal surface; 11, 31 labial surface; and 36, 46 lingual surface.

2.3.1 Criteria for classifying debris

0 = No debris or stain present
1 = Soft debris covering not more than one third of tooth surface of the presence of extrinsic stain without other debris, regardless of surface area covered
2 = Soft debris covering more than one third but not more than two third of the exposed tooth surface
3 = Soft debris covering more than twos third of the exposed tooth surface

Debris Index =[(The buccal-scores) +(The lingual-scores)] / (Total number of examined buccal and lingual surfaces).

2.4 Reasons for the decline of caries

The factors lying behind changes in caries prevalence in the children and adolescents have been discussed at many international dental forums. The occurrence of caries has been declining in communities with and without organized preventive program or fluoridation. It is assumed that the reasons are related to the use of fluorides, providing

dental sealant, education in oral hygiene so as to improve oral behavior, or to a change microbial, host and saliva factors or to dietary changes. It is suggested, however; that the most probable reason is related to the increase use of fluorides and dental sealant.

2.5 Fluoride

Fluoride is a mineral that is found naturally in all water sources. There are two types of fluoride, systemic and topical.

- Systemic fluorides are swallowed and benefit the teeth before and after they erupt in the mouth.
- Topical fluorides are applied directly to teeth and expectorated. Topical fluorides benefit teeth that have already erupted into the mouth.

Fluoride has substantial benefits in the prevention of tooth decay. While dental decay is reduced by fluoridated toothpaste and mouthrinses, professional fluoride treatments and fluoride dietary supplements. Widespread use of fluoride has been a major factor in the decline in the prevalence and severity of dental caries in developed countries. When used appropriately, fluoride is both safe and effective in preventing and controlling dental caries.

Consequently, fluoride principle to control dental caries is the procedure to adjust the oral environmental to contain fluoride ion in the mouth all time (or as long as possible) in order to exchange the mineral into teeth.

2.5.1 How Effective Are Fluoride?

Fluoride works to control early dental caries in several ways. Fluoride concentrated in plaque and saliva inhibits the demineralization of sound enamel and enhances the remineralization (i.e., recovery) of demineralized enamel. As cariogenic bacteria metabolize carbohydrates and produce acid, fluoride is released from dental plaque in response to lowered pH at the tooth-plaque interface. The released fluoride and the fluoride present in saliva are then taken up, along with calcium and phosphate, by demineralized enamel to establish an improved enamel crystal structure. This improved structure is more acid resistant and contains more fluoride and less carbonate. Fluoride is more readily taken up by demineralized enamel than by sound enamel. Cycles of demineralization and remineralization continue throughout the lifetime of the tooth.

Fluoride also inhibits dental caries by affecting the activity of cariogenic bacteria. As fluoride concentrates in dental plaque, it inhibits the process by which cariogenic bacteria metabolize carbohydrates to produce acid and affects bacterial production of adhesive polysaccharides. In laboratory studies, when a low concentration of fluoride is constantly present, one type of cariogenic bacteria, *Streptococcus mutans*, produces less acid. Whether this reduced acid production reduces the cariogenicity of these bacteria in humans is unclear.

2.5.2 Fluoride Toothpaste

Fluoride is the nonprescription toothpaste additive proven to prevent dental caries. When introduced into the mouth, fluoride in toothpaste is taken up directly by dental plaque and demineralized enamel. Brushing with fluoride toothpaste also increases the

fluoride concentration in saliva 100- to 1,000-fold; this concentration returns to baseline levels within 1-2 hours. Some of this salivary fluoride is taken up by dental plaque. The ambient fluoride concentration in saliva and plaque can increase during regular use of fluoride toothpaste.

2.5.3 Fluoride Gel

Because an early study reported that fluoride uptake by dental enamel increased in an acidic environment, fluoride gel is often formulated to be highly acidic (pH of approximately 3.0). Products available in many countries include gel of acidulated phosphate fluoride (1.23% [12,300 ppm] fluoride), gel or foam of sodium fluoride (0.9% [9,040 ppm] fluoride), and self-applied (i.e., home use) gel of sodium fluoride (0.5% [5,000 ppm] fluoride) or stannous fluoride (0.15% [1,000 ppm] fluoride).

Clinical trials conducted during 1940-1970 demonstrated that professionally applied fluorides effectively reduce caries experience in children. In more recent studies, semiannual treatments reportedly caused an average decrease of 26% in caries experience in the permanent teeth of children residing in nonfluoridated areas. The application time for the treatments was 4 minutes. In addition, the optimal schedule for repeated application of fluoride gel has not been adequately studied to support definitive guidelines and studies that have examined the efficacy of various gel application schedules in preventing and controlling dental caries have reported mixed results. On the basis of the available evidence, the usual recommended frequency is semiannual.

Because these applications are relatively infrequent, generally at 3- to 12-month intervals, fluoride gel poses little risk for enamel fluorosis, even among patients aged less than 6 years. Proper application technique reduces the possibility that a patient will swallow the gel during application.

2.5.4 Community water fluoridation (CWF)

Community water fluoridation (CWF), the basis for primary prevention of dental caries (tooth decay) for many years, is the controlled addition of a fluoride compound to a public water supply to achieve an optimal fluoride concentration. WHO recommended that community drinking waters contain 0.7–1 ppm (mgF/lite) of fluoride. For Thailand, the appropriate fluoride level was given at 0.5-0.7 ppm (Dental Health Division 2002).

Community water fluoridation has been recognized as one of great achievements in public health of the twentieth century because it has been linked to large reductions in tooth decay in many industrialized countries during the latter half of the century.

2.5.5 Fluoride mouthrinses

Fluoride mouthrinses have been shown effective both on a community and on an individual basis. There are two main methods of delivering rinses, low potency sodium fluoride at 0.05% and high potency 0.2% sodium fluoride. The former is delivered on a daily basis and the latter on a fortnightly basis. Recommendations for the use of fluoride mouthrinse include that they should not be used at children younger than 6

years of age, and they should only be used in high risk children. They are also appropriate for patients with orthodontic appliances.

Rinse is effective in reducing children's cavities up to 40% more than brushing alone (Heifetz, Meyers, & Kingman 1981). It can also strengthen teeth to prevent tooth decay. Additionally, rinse is not just a great cavity-fighting tool; it is effective in preventing decalcification (white spots on teeth) common in children who wear braces.

Instruct children less than 12 years of age in good rinsing habits to minimize swallowing. Supervise children as necessary until capable of using without supervision.

2.5.6 Fluoride paste

Fluoride-containing paste is routinely used during dental prophylaxis (i.e., cleaning). The abrasive paste, which contains 4,000 - 20,000 ppm fluoride, might restore the concentration of fluoride in the surface layer of enamel removed by polishing. One of many formulas of fluoride-containing prophylaxis paste is 1.23% APF paste with silicon dioxide abrasive. This fluoride paste contains fluoride 12,300 ppm. Usefulness of this paste are providing stain removing and polishing qualities for accurate diagnosis during oral health examination and helping children patients familiar with dental services.

While 'spot' application with a fluoride paste, solution or varnish may be effective in reversing the demineralization process in early enamel caries, that is, in noncavitated lesions, such topical applications cannot reduce significantly the numbers of microorganisms that are present within carious dentine; nor can such 'one-step' treatment slow the rate of progression of caries involving dentine. However, fluoride paste is not accepted by FDA (U.S.) or ADA as an efficacious way to prevent dental caries.

2.6 Pit and Fissure Sealant

The chewing surfaces of children's teeth are the most susceptible to decay and least benefited by fluorides. In almost half a century scientists have developed plastic films that are applied to these chewing surfaces of molars. This coating prevents the accumulation of plaque in the deep grooves on these vulnerable surfaces. Sealants are usually applied on the teeth of children, shortly after the molars erupt. Older people may also benefit from the use of tooth sealants. These dental sealants offer a new approach to the prevention of dental caries. Poor and minority children have far more cavities than other children. However, a school-based dental sealant program could substantially improve the dental health of poor school-aged children at no cost or only slightly increased cost relative to ordinary dental care (Zabos *et al* 2002).

2.6.1 Indication for dental sealant

Patients or their guardians should be made aware of the availability of sealants and, except where sealing is clearly inappropriate, given the opportunity to have sealants placed. Those individuals who can benefit from such treatment are:

1. Children with newly erupted teeth with pits and fissures.
2. Children whose lifestyle, developmental or behavioral patterns, or lack of fluoride exposure put them at high risk for dental caries.
3. Children with teeth that have pits and fissures that are anatomically susceptible to caries.
4. Other persons who desire sealant application and for whom sealant therapy is technically feasible.

2.6.2 How Effective Are Sealants?

Sealants are highly effective in preventing pit and fissure caries. The effectiveness of dental sealants in the prevention of tooth decay has been demonstrated in a variety of research findings covering many years. In the last several years, investigators in several countries have repeatedly demonstrated that caries protection is 100% in pits and fissures that remain completely sealed. Complete retention rates after one year are 85% or better and after five years are at least 50%.

Effectiveness is further increased if lost or partially lost sealants are replaced or repaired at visits subsequent to initial placement. The typical recall system in a private dental practice makes such replacement and repair convenient. Although recall is more difficult in community-based programs, it would enhance effectiveness in these settings as well.

It is suggested that sealants may also be used to arrest the progress of incipient or small pit and fissure lesions. Further exploration of this approach through careful clinical studies are to be encouraged (NIH 1983).

The American Dental Association's Council on Dental Materials and Devices (1976) has recommended that occlusal sealants should be checked at frequent intervals and reapplications should be considered in sites of teeth from which the sealant has been lost.

2.7 Oral health education

Oral health education is the oro-behavioral process which aims to establish, improve, and change individual behavior in long term to have good oral health status of himself/herself, family, and community. Furthermore, oral health education encourage person to learn and practice in order to improve oral health status and avoid some behaviors that can risk to oral disease. Oral health education incorporates tooth-brushing practice, diet counseling, and so on.

2.7.1 Problems of dental education in public schools

Kennedy (1979 cited by Harris & Christen 1991) has identified four prime reasons why there is a problem in preschool oral health education. These reasons, with some exceptions, are equally applicable to primary and secondary education.

1. Decision makers for preschool programs are not aware of the need and effectiveness of preventive dentistry practices that can be accomplished within a school environment.

2. Parents and community leaders are not committed to oral health.
3. Public health officials have not demonstrated aggressive leadership in establishing meaningful school oral health programs.
4. Individual dentists show little active support of school health programs.

To determine how to improve existing school dental health education programs, it is necessary to review the curriculum, the teaching, the support given by school administrators, parents, community leaders, legislators, and the dental profession.

2.8 Preventive Resin Restoration

The preventive resin restoration (PRR) is indicated when deep pits and fissures and poor oral hygiene have resulted in caries or defective areas that extend well beyond the surface but not quite to the dentinoenamel junction (DEJ).

The preventive resin restoration is a conservative occlusal restoration that involves replacement of discrete areas of carious tooth structure with composite, followed by application of an overlying fissure sealant, instead of the traditional "extension for prevention" (Simonsen 1980).

2.8.1 Indication for PRR

1. Children who have no, or only minimal pit and fissure staining
2. Children who have minimal “catches” in the grooves, or areas with distinct incipient enamel caries.

2.9 School-based oral health program

Treatment is not the answer to solving children’s oral problems; instead, prevention is the key to good dental health. The American Dental Association (ADA) has established a policy that dental health is the responsibility of the community, the family, and the individual (Jenny & Frazier 1974 quoted in Harris & Christen 1991). According to this enunciation, the responsibility for good dental health resides with the consumer, not the provider.

2.9.1 Guidelines for an ideal school dental program

A comprehensive school program should

- Be administratively sound;
- Be available to all children;
- Provide the facts about dentistry and dental care, especially about self-care preventive procedures through oral hygiene instruction;
- Aid in the development of favorable attitudes toward dental health;
- Provide the environment for the development of psychomotor skills necessary for tooth-brushing and flossing;
- Include primary preventive dentistry programs-prophylaxes, fluoride programs, and use of pit and fissure sealants;

- Provide screening methods for the early identification and referral of pathology; and
- Ensure that all discerned pathology is expeditiously treated.

2.9.2 Advantages of a comprehensive school-based program

There are several advantages to a school-based program (Dunning 1986 cited by Harris & Christen 1991):

1. The children are available for preventive or treatment procedures
2. School clinics are less threatening than private offices
3. A school dental program facilitates central education on dental subjects
4. Dental services supplement the nursing services by helping to provide total health care for school children.

2.10 The economics and evaluation of dental care and treatment

Economics is about choice. Choices raise a number of different contexts in dentistry. At the most aggregated level there are choices about how many resources to allocate to dental care as opposed to other areas of economic activity. Within dental care, too, there exist a large number of choices *How much* of *what type* of treatment should be provided and *for whom? When* should care be provided? (What are the relative costs and benefits of preventive versus restorative care?). *Who* should provide it? (What are the possibilities for substitution between, for example, dentists and dental assistant?) *Where* should care be provided? (E.g. fixed vs. mobile clinics) (Yule, Amerongen, & Schaik 1986).

2.11 Dental health status measurement

Fortunately dental caries is more easily measured than the output of most other health care programs. Dental health can be calculated into monetary terms (cost-benefit analysis) and when it cannot be measured in monetary term; there is another method, cost-effectiveness analysis (CEA) which effectiveness is measured in terms of a health status indicator. The type of indicator required depend very much on the purpose for which it is to be used. The results may be stated either in terms of cost per unit of effect, or effects per unit cost. Costs can be in monetary terms but outcomes are in terms appropriate to the treatment provided, e.g. number of carious lesions prevented (Deery 1999). Thus an index for evaluating the dental health of whole populations is likely, on grounds of practicality, to be a much cruder instrument than that needed to evaluate particular treatments. Likewise, it is important to recognize that indicators constructed for use in clinical evaluation may not be ideal for economic evaluation, and vice versa.

However, the most commonly used indicators of dental health are the measures of caries prevalence, the DMFT indices (decayed, missing and filled teeth) (Yule, Amerongen, & Schaik 1986).

2.12 Socio-demographic and risk factor of dental caries

People – individuals or whole populations – are exposed all their lives to almost limitless risks to their health. Over the past decades a large number of research reports have shown that dental caries is linked to social and behavioral factors. Petersen (2005b) said that the socio behavioral risk factors have been found to play significant roles in the occurrence of dental caries in both children and adults worldwide.

There are several factors found to be significantly related to the prevalence and/or incidence of caries in children, for instance; age, gender, race/ethnicity, public/private school, frequency of tooth brushing, water fluoride level, rural or urban (Harris, Nicoll, Adair, & Pine 2004).