

CHAPTER 5: DISCUSSION

5.1 Socio-demographic characteristics of proxy population (5-6 years old).

The sociodemographic characteristics of most of the parents in the proxy population indicate that they were at the productive age for building families (ie. aged 20-49). This category may also be considered as economically productive age. Therefore, it is important to tackle general health and oral health problems through intervention programs of toddlers and preschoolers. The majority in the proxy population were Malays which reflect that of Kelantan population. Not many of parents were highly educated at tertiary level education, so any targeted intervention program of health education and health promotion to increase the awareness of health must focus on mothers with secondary level education. The majority of parents have large families (>6 members) and most were married at young age. Most of them were poor, who lived below the official poverty line.

On average, they spent more than two-thirds of their total monthly income on food. Less than one-half of them obtained their water supply from centralized piped water system which was not fluoridated. The majority (54.1%) used other sources such as wells, river or pond water. Therefore, the socio-demographic characteristics of this population revealed that the majority was poor, lower educated, married early, have large families, spent almost two-thirds of income on basic necessity such as food and depend on free untreated water supply for their daily needs. Thus dental expenses would be expected to be a very low priority in this population.

Leake *et al.*, (2008) and Finlayson *et al.*, (2007) reported children who come from family of lower socioeconomic class and lower parental education level are at higher risk for ECC. Inadequate access to healthcare is also high among low

socioeconomic status families, which put their children at greater risk for ECC (American Academy of Pediatric Dentistry, 2007).

5.1.1 Early Childhood Caries status of Proxy Population (5-6 years old).

The caries experience in this proxy population was very high. Each child had on average about 11 carious teeth per child. Out of this, on average, only less than one tooth was filled or missing. In other words, the vast majority of the ECC was untreated, by fillings or extraction. Untreated decayed teeth are the most important contributor to oral pain and discomfort in children. A recent study in Malaysia reported that ECC impacted negatively on the quality of life of the preschool children, their mothers and their family (Zakiah, 2011).

In fact, the prevalence in the present study was much higher as compared to the national report from the Oral Health Division, Ministry of Health, Malaysia (2007), where the prevalence of caries was 76.2% among 5 year old preschool children. The national mean dmft was 5.6 (sd 5.26), with wide gap between the most developed state (eg. Federal Territory Kuala Lumpur dmft 2.3 (sd 3.40)) and the least developed state in Malaysia (eg. Kelantan dmft 10.0 (sd 4.79) respectively.

In this proxy population, there was almost no child not affected by caries (99%). Each child carried a very heavy disease burden of more than 7 teeth affected. This is considered as high or rampant caries. In other words without a more effective and systemic intervention strategy, ECC was both highly prevalent and severe in these areas. Thus it justified why a health promotion intervention program is urgently needed in Kelantan.

5.1.2 Nutritional Status for proxy population (5-6 years old)

5.1.2.1 Nutritional Status: Anthropometry measurements for proxy population (5-6 years old).

The proxy population also had a severe prevalence of malnutrition in preschool children (WAZ) which affected about one-half of the population. Compared with the Third National Health and Morbidity Survey (NHMS III, 2006; Khor *et al.*, 2009), the national prevalence of underweight in Malaysia for WAZ (ie below -2sd) was much lower at 12.9% as compared to the present study (36.1%).

More than 1 in 3 preschool children were stunted, about 1 in 10 moderately stunted, while 1 in 20 severely stunted. Meanwhile, the prevalence for stunted (HAZ below -2sd) in the present study was much higher (24.6%) compared to national prevalence of stunted preschool children in Malaysia (17.2%) (Khor *et al.*, 2009).

The dilemma of nutrition transition from inadequate to overnutrition intake as noted by Tee (1999), due to increased of dietary energy, total fat and protein, refined carbohydrate and animal products intake, was also faced by some children in the village. What we can see here was although one-third of the preschool children were underweight, about eleven percent (10.8%) was overweight/obese in BMI-for-age. This shows that the double burden of underweight and overweight also prevailed in this disadvantaged community.

In comparison with other Asian countries, the prevalence of overweight in the present study was considerably higher (31.1%) compared to children in the Philippines (26.2% - FNRI, 2008), Vietnam (25.2% - Vietnam MOH, 2001) and Indonesia (27.5% - Atmarita, 2005). However, the prevalence of stunting of preschool children in the present study was lower (24.6%) as compared to Philippines (27.9% - FNRI, 2008), Vietnam (29.6% - Vietnam MOH, 2001) and Indonesia (45.6% - Atmarita, 2005).

5.1.2.2 Nutritional Status: Nutrients and sugar intake for proxy population (5-6 years old).

The nutrient intake of preschool children in the proxy population met about two-thirds of the daily intake proposed by the Malaysian Recommended Nutrient Intake standards (NCCFN, 2005). This may be due to the fact that most of them are poor, with low household income below the national poverty level. In addition, many families consists of a large family members (>6 members), thus in terms of per capita income distribution, they simply cannot afford to distribute quality food to all family members especially children.

Most of the families had low level of education and married young. This was reflected by many mothers who are housewives and most of their husbands worked in the village (“kerja kampung”) and earned unpredictable low monthly incomes. With escalating food prices, the affordability to buy quality foods was reduced especially in poor families.

Bouis *et al.*, (2011) in their study on food prices, household income and resources allocation from the socioeconomic perspectives and their effect on dietary quality and nutritional status showed that a 50% increase in food prices results in a decrease in energy intake of 5% to 15%. However, it also depended on the strength of the induced income effect.

Meanwhile, iron intake was higher (about 20.5%) as compared to the daily recommended RNI (2005). This may be due to high intake of fried chicken as their favorite food. The accessibility of chicken at night markets which is cheaper and more affordable for the family to buy for their children. Adequate iron intake in the diet was associated with academic performance in young children as reported by Hamid *et al.* (2011).

Unfortunately, the amount of added sugar intake was very high, up to 205% more as compared to the WHO (2003) recommendation. Excessive intake of added

sugar contributes to overweight and obesity (Ludwig *et al.*, 2001), the development of type 2 diabetes mellitus (Schulze *et al.*, 2004), lower nutrient intake especially of calcium (Mrdjenovic & Levitsky, 2003), lower bone density (Soroko *et al.*, 1994) and higher dental caries development (May & Witerhouse, 2003). A recent press report stated that Kelantanese children below the age of six face tooth decay woes higher than the national average (The Star (Nation), Thursday 24 November 2011. Page 32). While the paper report attributed the main cause as lack of water fluoridation in the state, the present study also showed that their sweet tooth habits are also to blame. The diabetes rate among adults in Malaysia is also one of the highest in Asia (Letchuman *et al.*, 2010). Thus both strategies (ie. water fluoridation and sugar reduction) must be employed together in order to be effective.

The timing of added sugar intake introduced to children is very crucial and depends on the mothers. More than two-thirds of mothers, the majority of whom had low level of education and low family income; tend to introduce sugary foods and drinks at early age to their children. There was significant association between caretaker's level of education with sugary drinks intake in young children as reported by Marshall *et al.*, (2003). A qualitative study on sugary beverage intake of babies and children in Wales showed that mothers who had low knowledge on nutrition was a significant dependent factor of sweet beverages intake (Chestnut *et al.*, 2005).

In practice, it was observed that it was expensive for poor families to provide formula milk to children. Fresh milk was also expensive, not widely accessible in rural shops as well as not a dietary culture of rural populations. Instead they replaced it with sugary "health" drinks like "MILO" (a purported chocolate based health drink marketed to children) with added sugar or sweetened condensed milk and these are put in a bottle with rubber teats. Tea or coffee are rarely drunk pure, but with generous amounts of

sugar or sweetened condensed milk. With this type of high risk habits, the caries incidence will remain high in this disadvantaged community.

According to a study by Dubois *et al.*, (2008), children from families with insufficient income consumed more sugar-sweetened beverages regularly between the ages of 2.5 and 4.5 years and are more than three times likely to be overweight at age 4.5 years as compared to non-consuming children from sufficient income households.

A study which estimated added sugar consumption in Malaysia reported that about 59% of the population consumed added sugar every day. Most of them usually added it to beverages such as tea, coffee and chocolate-based drinks (Norimah *et al.*, 2008). Thus the high sugar intake habit may be considered as a cultural phenomenon as well as a national problem, but more so in the Kelantanese population.

5.1.3(a) Dietary Habits: Frequency Intake of Sugary foods and drinks for proxy population (5-6 years old).

In general, several types of sugary foods and drinks were consumed two to three times per day and a very high score was observed for chocolate based drink (with sugar or sweetened condensed milk) or “milo”, “cokelat” (a local slang for sweets) and ice-cream. This finding was not in line with the Malaysia Recommended of Nutrients Intake (NCCFN, 2005), which advised that Malaysian population should consume a variety of foods and eat less sugar intake.

During the transition from liquid to solid foods, parents are the major influence on what their children eat in terms of the quality of their diet and their weight status (Savage *et al.*, 2007). However, dietary habits seem to have shifted in all age group in the Western populations in recent decades, including a nearly doubled intake of energy-dense, low-nutrient snack food (Briefel and Johnson, 2004; Adair and Popkin, 2005). This trend confirmed Grindekjorg *et al.*, (1996) study which found that caries in children prior to the age of 2.5 years was associated with candy consumption, while the

development of caries between 2.5 and 3.5 years was associated with candy consumption and consumption of sugar-containing drinks. Wendt and Birkhead (1995) found that the consumption of a variety of sugar-containing products such as soft drinks, candy, ice cream and biscuits were all individually associated with increased caries risk. In Malaysia, research on sugary foods and drink consumption associated with dental caries among preschool children by Zahara *et al.*, (2010) found that the majority of the preschool consumed sugary food and drinks more than 3 times per day.

Such sugar intake behaviors favor the intake of nutrient-poor foods which can increase the risk of obesity and dental caries (Marshall *et al.*, 2005; Dubois *et al.*, 2008). The American Academy of Pediatric Dentistry's policy recommended that to decrease the risk of caries for infants, children and adolescents, a balanced diet is needed (Clinical Affairs Committee AAPD, 2008).

There are many reasons why added sugar intake was high among preschool children. First, is due to food cost, where energy-dense foods are generally more palatable and can be purchased at a lower marginal cost than healthier alternatives (Drewnowski and Darmon, 2005). Second, marketing and sales promotion of high-fat snacks and carbonated, sweetened beverages has been intensively promoted and has marketing appeal for children to buy (French *et al.*, 2003). There is aggressive marketing for candy, snacks, sugared cereals and fast food that is targeted toward children (McGinnis *et al.*, 2006) and available at outlets around the house. Finally, it is the Malaysian government's policy in the form of sugar subsidies which makes the sugar intake habits very affordable to every family. Mobly *et al.*, (2009) summarized that factors like socioeconomic status (SES), the cost of food, the industrialization of agriculture, the location of food outlets and the effects of advertising and marketing influenced what people eat daily.

5.1.3 (b) Dietary Habits: Frequency Intake of Fruits and Cariostatic Foods for proxy population (5-6 years old).

A diet can be considered as having “variety” when the diet contains foods in all the food groups in the food pyramid (MOH, 2010). As recommended in the Food Pyramid (second level), fruits consumption should be taken 2-3 times a day. Fruit consumption prevalence in this proxy population was lower than the guidelines based on the low percentage of 2 to 3 times intake per day. Most of them have taken fruits only 2 to 3 times a month which is inadequate as compared to the recommendations.

Most parents in this proxy population are poor thus affordability to buy is low. In addition they were not highly educated which probably meant that the level of awareness of the importance of fruit intake to health was also low. As noted by Hilsen *et al.*, (2011), the frequency of fruit intake among children had a significant interaction with parental education. In that study, fruit intake decreased among pupils of parents with lower education, but increased among pupils of parents with higher education. According to Kim *et al.*, (2011), high intake of fruits is associated with decreased risk for many chronic diseases and may assist in weight management (obesity), but the present study showed that few children consumed the recommended amount of fruits.

There are reports stating that the fruits intake can cause tooth erosion (Stabholz *et al.*, 1983). Most fresh fruit have a sugar content of 10 to 15%, which is sufficient to penetrate plaque and be used by bacteria to produce acids. In addition, most fruits are naturally acidic that is able to demineralize the enamel if it remains in prolonged contact with it. However, the erosion cases reported due to fruit consumption mainly involved individuals who consumed as many as 20 fruits per day, or those who sucked on acidic fruits such as oranges or lemons, which had the effect of placing their teeth in direct contact with the acidity of the fruit. This is not the case when fresh fruits are eaten twice or three times a day, even bananas which have a slightly higher sugar content and

stickier texture (Monique, 2006). In other words, to prevent the tooth erosion; the consumption of fruits should follow the food pyramid frequency as recommended.

Further, yogurt (found under milk and milk products in the Malaysian Food Pyramid) consumption was not popular among preschool children with more than one thirds “less frequent” intake and a very low percentage (1.3%) for 2-3 times a day). The suggestion of milk and milk products was 1 to 3 servings per day and should be eaten in moderation. As noted, yogurt has the same characteristics as milk and is good for healthy teeth. In fact, its content in lactose which is the least cariogenic, is relatively low in sugars, and contains calcium and phosphate ions that prevent the dissolution of the enamel (Monique, 2006). However we acknowledge that milk and yogurt intake is not a cultural norm in the Kelantanese diet. This may explain why there were more children who are under weight or stunted due to lack of variety in sources of protein.

5.1.6 Knowledge, Attitude and Practices (K/A/P) for proxy population (5-6 years old).

Parental knowledge and attitude towards oral health are important to prevent the occurrence of dental caries among children (Saied-Moallemi *et al.*, 2007). Parents with good knowledge and attitudes towards oral health can promote better oral health in their children (Mattila *et al.*, 2000, Taani, 2002). For example, mothers with good knowledge and attitude will influence them to brush their children teeth from an early age, supervise their children’s tooth brushing and monitor their children’s frequency of fermentable carbohydrate intake. However in this proxy population, more than two-thirds (68.1%) of mothers were moderate in knowledge and nearly 6 % (5.5%) of them were low in basic knowledge about nutrition and oral health. About one-half of mothers were moderate in attitude and one-third of them were low in attitude scores in this proxy population. Therefore, with majority of mothers with low knowledge and attitude scores in nutrition and oral health, it may contribute to poor selection of quality foods for

example more sugary foods consumption was introduced at an early age which will harm the children's teeth.

Brushing of young children's teeth is important to prevent caries. According to Saied-Mollemi (2008), mothers who supervise their children's tooth brushing daily, have children with better oral health. High motivation and support from parents are needed to brush their child's teeth daily. Huebner and Rieday (2010) reported that parents, who believe that home oral hygiene is important and it is their parental duty, tend to brush their children's teeth twice daily compared to those parents who think that home oral hygiene is not important. The most common barriers reported by parents to brush their children's teeth were due to lack of time and uncooperative child (Huebner and Riedy, 2010).

The proxy population showed that more than one-half of mothers were "moderate" in practices of nutrition and oral health. The feeding pattern and eating practices controlled by parents is needed to be free from dental caries. Improper child rearing practices can become important risk factors for caries in primary teeth especially when sweet liquids or milk is given to children and left clinging to the infant's teeth for a period of time. Bacteria use these sugars as food, which produce acids that attack the teeth; finally the teeth can decay. It is not only about putting the bottle of milk in the child's mouth, but how often and how long a period of time. Allowing the child to fall asleep with a bottle of milk or sweet juice during naps or at night can harm the child's teeth (American Academy of Pediatric Dentistry (<http://www.aapd.org/pediatricinformation/brochurelist.asp>)).

Even, the association between the prolonged breast feeding of more than 12 months and caries is still questionable (Gutkowski, 2007). Rosenblatt (2004), found there was no significant association between breast feeding and ECC. Majority of the breast fed children in their study just breast fed up to 6 months old (Rosenblatt and

Zarzar, 2004). However, bottle feeding at night which contains milk or other cariogenic agents (like juices or water containing sugar) is a significant determinant of ECC. This practice should be avoided to reduce the incidence of ECC (Hallett and O'Rourke, 2006).

Thus from the foregoing section, we can summarize that there was very strong evidence of a very high dental disease burden (ECC) and malnutrition levels (underweight / stunting) existed in the proxy population of 5-6 year old preschoolers in Pasir Mas and Tumpat districts of Kelantan. This can give us a reasonably adequate scenario of what will happen to the current population of 2-3 year old toddlers (ie. Initially caries-free; test versus control population) IF no effective health promotion intervention program is carried out.

Thus the present thesis was designed to develop, test and implement an integrated oral health and general health promotion program (called the TIPTOP program) as an intervention to prevent / reduce ECC as well as reducing underweight / stunted children in a longitudinal study. The details of the TIPTOP intervention which combined elements of dental and nutritional approaches are as described in the Materials and Method Section. The following section will present the discussion on the effectiveness of that intervention in 2-3 year old toddlers who were initially caries-free at baseline and were followed up for a period of 18 months during the allocated study period.

5.2 The Effectiveness of Health Promotion Intervention Program (TIPTOP program)

The following section will discuss about the impacts of the intervention health promotion program (viz. the TIPTOP program) on a cohort of 2-3 year olds who were caries-free (dmft=0) at baseline ie. Before intervention. The preschool children were divided into two groups: (a) the intervention group (who followed the TIPTOP program module) and (b) the control group (who followed the normal toddler oral health program run by the Oral Health Department, Ministry of Health). In order to establish whether at baseline both groups are comparable in all socio-demographic aspects, except the type of intervention, the following section will discuss the selection of the intervention and control groups.

5.2.1 Selection of Intervention and Control Population.

Based on the results of proxy population, almost every child aged 5 to 6 years old in both districts of Pasir Mas and Tumpat districts was affected by caries (97.9%), one-half were underweight (50.5%) of WAZ, one-third (about 40.1%) were stunted of HAZ, less than one-third (31.1%) were underweight of BMI-for-age, the majority had nutrient intake which were not adequate as compared to Malaysia Recommended Dietary Intake (NCCFN, 2005), added sugar intake was very high as compared to WHO (2003) standards, overall frequency intake of sugary foods and drinks was excessive, overall frequency intake of fruits and cariostatic foods was not adequate as recommended and the majority of parents had only moderate knowledge, attitude and practice scores related to nutrition and oral health. The cross sectional analysis of the above variables showed that there was no statistically significant difference in all of the above parameters between both districts ($p > 0.05$). In other words they were comparable in all aspects in the proxy population. Therefore it was safe to assume that there would

be no significant difference in socio-demography in the 2-3 year old intervention and control population.

Very few studies have investigated the effectiveness of education programs on ECC (Ismail, 1998; Weintraub, 1998) and only one examined the effect of such interventions (ie. oral health and general health) on dental caries in the first year of life (Feldens, 2007), before the ECC become severe and extremely difficult and expensive to treat (Ramos-Gomes et al, 2002). As reported by Feldens (2007), home visits were effective in preventing early childhood caries, and there was a decrease in ECC from 18% to 10% when intervention was introduced early (12 to 16 months). In fact, the present study was the first longitudinal health promotion intervention study on oral health and nutrition at an early age in Malaysia.

In our implementation to prevent oral health and general health problem, the TIPTOP program has been planned and implemented on children aged 2-3 years old and followed up for one and half years in the high risk district. Before implementation of the TIPTOP program, toddlers who attended the Ministry of Health toddlers health program (n=519) from both districts (Pasir Mas and Tumpat) were screened to select children who were caries free. At the end of screening phase, only 15.8% (n=82) toddlers was caries free, consisting of 41 toddlers from Pasir Mas and 41 toddlers from Tumpat district. One district was chosen to be the intervention (test) group, while the other was assigned the control group. However during the intervention, one toddler from Tumpat district dropped out when the parents moved to other districts. So, the final sample was 81 toddlers (Pasir Mas n= 41 and Tumpat (n=40) which were successfully followed up until the end of study period.

An important thing to note was that even at 2-3 years old, it was extremely difficult to find a caries-free toddler to be included in the sample although we had visited all available health centers in both districts. This shows the seriousness of the

ECC problem in Kelantan. The 81 toddlers selected met the inclusion criteria of permanent residence as well as caries-free at baseline. We could not increase the sample size in the intervention phase because there were no more 2-3 year old toddlers to screen.

5.2.2 Socio-demographic distribution of family of toddlers 2-4 years old.

In order to ascertain that the intervention and control group are as similar as possible before implementing the program, the following discussion focused on the socio-demographic distribution of their families. The results showed that the majority of mothers (87.5%-Intervention & 87.8% -Control) of intervention and control group were at the same cohort of reproductive age (19-39 years old), majority were Malays, more than three-quarters (ie. 90%- Intervention & 95.1%-Control) had secondary or tertiary level of education, about one-half were housewives (58%-Intervention & 41.5%-Control) and more than three-quarters depend on water supply which is not fluoridated (75%-Intervention & 82.9%-Control). About one-fourths (27.5%-Intervention & 26.8%-Control) of family earned household incomes less than the poverty line and from the total income one-third (33.6%) of that were spent on food in both locations. The distribution of family size was also equal in intervention and control group. Thus we conclude that there was similarity in all aspects of socio-demographic characteristics in both intervention and control group at baseline.

5.2.3 Impact and Outcome of the TIPTOP program.

5.2.3.1 Impact of TIPTOP Program in Controlling Early Childhood Caries.

In both groups, the prevalence of ECC increased over the study period. However, what is more important was that the increase in the intervention group was significantly lower than the control group by about 30% ($P < 0.01$). This percentage reduction was comparable to reductions produced by fluoride intervention reported in other studies (Marinho *et al.*, 2004). Furthermore, the reduction was produced despite the absence of water fluoridation in Kelantan in particular at Tumpat and Pasir Mas. Report from Oral Health Division, Ministry of Health, (2007) revealed that mean dmft was lower among 5 year old children in Malaysia in the area with water fluoridation eg. Johor (3.5(sd 4.22)) as compared to the state with no water fluoridation eg. Kelantan (10.0 (sd 4.79)). Therefore, we speculate that the reduction could have been more in the intervention group if there was water fluoridation. Although the control group may also benefit from water fluoridation, the intervention group will have further benefited from water fluoridation as well as the TIP TOP program. In other words, the TIPTOP program emphasizing oral health education and nutritional advice was proven successful in reducing ECC incidence among toddlers in Kelantan.

The impact of the TIPTOP program have produced more children with no caries (dmft=0) and no children with high caries (dmf>7) as compared to the control group. These findings demonstrate that toddlers in the TIPTOP program whose mothers received early diet and nutrition counseling had reduced caries incidence as well as severity. In other words, there is strong evidence that Health Promotion program was successful in producing the intended outcome.

We noted that all the dmft score was contributed by the decay component (dt). In other words, none of the caries teeth had been treated or extracted (yet) during the duration of study period. When compared to the ECC experience of the proxy

population (Table 4.1.2), the Ministry's recently introduced treatment program for toddlers seem to have very little impact in terms of extraction (mt=0.14) and fillings (ft=0.04). This may be due to the fact that the Ministry of Health's current policy is to give priority coverage for primary school children aged 6-12 years through the School Dental Service program due to acute shortage of manpower. Treatment to preschool population had to be neglected as long as the caries situation in primary schools cannot be controlled. The shortage of dentists in Kelantan was serious. The ratio of dentist: population for Kelantan was 1:19,115; in Tumpat 1:21,650 and in Pasir Mas 1:17,658 as compared to the national average of 1:8000 (Health Information Management System, Ministry Of Health (2011). Therefore we recommend that dental nurses (therapists) be redeployed from primary schools to tackle the serious ECC problem in preschools and toddler programs by adopting the TIPTOP program protocol.

5.2.3.2 Impact of TIPTOP program in Controlling General Health.

The implementation of the TIPTOP program reduced not only the caries incidence but also produced positive results for general health in particular nutritional status (viz. HAZ, WAZ and BMI-for-age), dietary intake and dietary habits as well as knowledge, attitude and practices. The following discussion section examines the impacts.

5.2.3.2.1. Anthropometry measurements

In both groups, significant changes between intervention and control group after 18 months of intervention period of WAZ ($p < 0.01$) and HAZ ($p < 0.05$) were observed. The prevalence of normal WAZ, HAZ and BMI-for-age increased over the study period in the intervention group. On the other hand, the opposite was observed in the control group in which the prevalence of normal of WAZ ($p < 0.01$), HAZ ($p < 0.05$) and BMI-

for-age ($p>0.05$) was much less than the intervention group. The significant changes from underweight to normal and overweight to normal was also seen in the study done by Reinehs (2011), in which they demonstrated only a moderate effect on weight loss (<10% success rate 2 years after the onset of intervention).

The impact of TIPTOP program have produced more children with normal of WAZ, HAZ and BMI-for-age and no children with moderate underweight, stunted and overweight. However, the underweight problem still exists in the intervention group. A possible explanation of the malnutrition problem was caused by inadequate nutrient intake especially protein sources which are relatively more expensive for those families who live below the poverty line. A balanced diet is a major factor in maintaining good health. In developing countries, macro and micronutrient deficiencies have significant impact on anthropometry, immune competence as well as disease burden and outcomes of illness (Buzina-Suboticanec *et al.*, 1998); Pettigrew *et al.*, 1984). A similar outcome was observed in hospital based children and in the community, where overall prevalence of underweight was 23% and 14%, respectively (Felix *et al.*, 2010).

Without receiving the TIPTOP package, more than one-half (58.6%) of toddlers in the control group was underweight (moderate and severe), two-thirds (65.9%) was stunted (stunted and moderate) and 19.5% was thin by BMI-for-age. Studies showed that there was a relationship between malnutrition (Protein-Energy-Malnutrition/PEM), enamel hypoplasia and primary dentition caries (Kanchanakamol *et al.*, 1996). Other cross-sectional studies showed increased primary dentition caries levels in stunted children (Alvarez *et al.*, 1988; Cleaton-Jones *et al.*, 2000; Li *et al.*, 1996).

In addition, two cross-sectional studies have shown increase in primary dentition caries to be associated with wasted and stunted children (Alvarez *et al.*, 1990; Cleaton-Jones *et al.*, 2000). There was evidence in a longitudinal study in Peru which suggested that a single, prolonged, mild to moderate malnutrition episode in the first year of life

may result in higher primary dentition caries rates, an increase in permanent dentition caries and that the caries may be mediated by means other than enamel hypoplasia (Alvarez *et al.*, 1995). Therefore we conclude that more effective preschool children and toddler health intervention is very important and urgently needed.

5.2.3.2.2. Nutrients and Added Sugar Intake.

As a whole, the intervention group had achieved a moderate improvement in nutrient intake. In fact, the improvement of nutrient intake in the intervention group fared generally better than control group after 18 months of intervention period. However, vitamin A intake did not fulfill the RNI requirement for toddlers in the intervention group. The best sources of vitamin A are fruits and vegetables with deep yellow/orange, red and dark green colors like pumpkin, carrots, spinach, mango, watermelon etc. Inadequate daily vitamin A intake was correlated with inadequate daily intake of fruits where only a small percentage had intakes of 2 to 3 times a day (refer to Appendix A). One of the barriers to this was mainly the cost of fruits and vegetables that was the major constraint for household not consuming fruits and vegetables (Faber *et al.*, 2011). However in Kelantan we observed that the culture of eating fruits and vegetables 2-3 times a day may not be popular although the local fruits and vegetables are relatively inexpensive as compared to protein sources.

In the intervention group, fat intake seems to be inadequate compared to RNI (2005). However, according to Williams *et al.*, (1998) and American Academy of Pediatrics (1992), if intake of calories, high quality protein and essential nutrients is adequate, dietary fat intake can be reduced to not more than 30% of calories between the ages 2 to 5 without impairing growth and development.

It is remarkable to note by education and supporting mothers of toddlers who received the TIPTOP program, the intakes of essential nutrients such as protein,

calcium, and iron as well as energy intake among their toddlers had improved. Lack of essential nutrients intake during development stage can cause health problem. An example, a study showed there was significant association between low growth in childhood with an increased risk of coronary heart disease (Eriksson *et al.*, 2001).

In both groups, the added sugar intake was significantly different between intervention and control group ($p < 0.01$). The mean changes were higher in the intervention group as compared to the control group. However, there was greater improvement (ie. 50% reduction) of added sugar intake in the intervention group over the study period. In contrast, there was an increase of 29.3% added sugar intake in the control group. In other words, toddlers who did not receive the TIPTOP package were more exposed to high sugar intake which eventually can lead to general health and oral health problems in the long term. Once the high sugar habits become ingrained into their lifestyle it is more difficult to change to low sugar intake behaviour later.

Free sugars in the daily diet promote a positive energy balance (ie. Excess). Studies on human volunteers have demonstrated that there was increased in total energy intake when the total energy density of the diet is increased, whether by added sugars or fat (Stubbs *et al.*, 2000; Rolls and Bell, 2000; Rolls, 1997). Diets that are limited in added sugars have been shown to reduce total energy intake and induce weight loss (Smith *et al.*, 1996). Drinks that are rich in added sugars increase overall energy intake by reducing appetite control. There is less compensatory reduction of food intake after the consumption of high-sugar drinks than additional food intake of equivalent energy content (Ludwig *et al.*, 2002; Ebbeling *et al.*, 2001; Ludwig *et al.*, 2001). In fact, some human studies show that the frequency of sugars intake is an important etiological factors for caries development (Sreebny, 1982; Karlsbeek *et al.*, 1994). Thus sugar intake among preschool children and toddlers in Kelantan must be given priority to be tackled seriously to avoid serious health and dental problems later in life.

In summary, the TIPTOP program have produced at the end of intervention, essential nutrients intake which is good to oral health as well as general health for children to achieve normal growth. In addition, added sugar intake of toddlers in the intervention group was lower than that recommended by WHO, (2003). This shows that it is possible to influence the Kelantan population who are well known in Malaysia to have a sweet tooth, to a healthier alternative lifestyle

5.2.3.2.3 Dietary Habits of Sugary Foods and Drinks, Fruits and Cariostatic Food Intake.

The TIPTOP program reduced not only the number of children affected by ECC, but also improved their foods intake habits. Such a broad reaching result supports the contention that future strategy to prevent ECC should focus primarily on preventing their initiation rather than on controlling their severity (Kowash, 2006).

In the present study, there was a reduction in the frequency of sugary foods and drinks intake at the post intervention phase in the intervention group for almost every type of foods and drinks. Many studies have shown that decreased consumption of foodstuffs with high sugar density and low sugar meals and snacks contribute to lower caries among children (Ismail, 2003; Perez *et al.*, 2005; Nunn *et al.*, 2009; Thitasomakul *et al.*, 2009; Warren *et al.*, 2009). Quality diets along with better dietary practices in children was 44% less likely to exhibit severe ECC compared with children with the worst practices (Nunn *et al.*, 2009).

In the intervention group, there was greater compliance in term of avoiding sweets, soft drinks, honey and biscuits after receiving the TIPTOP package. This may reduce caries occurrence because sucrose, the most widely used sugar, and glucose and fructose from fruit juices and honey are the main sugars associated with ECC (Hallett, 2002; Moynihan *et al.*, 1996).

On the other hand, in the control group, the majority increased their frequency of sugary foods and drinks consumption at the end of the study period. Excessive intake of sugary foods and drinks consumption was linked to poor intake of key nutrients (Frary *et al.*, 2004), higher dental caries (Sohn, 2006), increased risk of bone fractures (Ma and Jones, 2004) and body weight status problems (Berkey *et al.*, 2004; Striegel-Moore *et al.*, 2006; Troiano *et al.*, 2000).

The intervention group showed increased in fruits intake after 18 months of study period but the percentage of increased consumption 2 to 3 times a day was small. However, there was a large increasing of fruits intake consumption of 2 to 3 times a week, except for apple and grapes. As according to Malaysia RNI (2005), the recommendation of daily fruits consumption was 2 to 3 servings per day and they should eat plenty. In conclusion the consumption of fruits intake has still not met the daily requirement, although there was an improvement.

Barriers to increased fruit intake may be due to unavailability and high cost of fruits. Other studies have cited cost as one of the barriers for healthy dietary change (Glanz *et al.*, 1998). The majority of families in both intervention and control group had low family incomes below the poverty line as well as large number of family members of 6 to 10 persons per family. Thus their per capita income might not be able to purchase fruits for daily consumption if they have big family size or other financial essential commitments. Household income was significantly associated with food purchasing behavior via food cost concern (Turrell and Kavanagh, 2006).

Another barrier cited was that there was no role model at home who implemented healthy eating habits at home, particularly of fruits intake (Mobley *et al.*, 2009). For example, as a role model, parents should encourage eating of fruits by regularly serving them at meals and eating it themselves. Baker *et al.*, (2008), reported that mothers with lower educational attainment were associated with less fruits

consumption, as well as high-fat and sugary foods that are often associated with caries risk. In addition, many studies concluded that increasing the consumption of fresh fruits in the diet was likely to decrease the level of dental caries in a population (Moynihan *et al.*, 2004). Yogurt, a known cariostatic foods which may protect against dental caries increased in the intervention group. The main ingredients of yogurt was milk which contains lactose and also calcium, phosphorus and casein, all of which are thought to inhibit caries in terms of fall of plaque pH after consumption (Rugg-Gunn, 1985).

Increased consumption of sugar-sweetened beverages, candies, chips and cookies provides excessive calories to the child, increases the risk of caries and when combined with inadequate intake of fruits and vegetables, deprives the child of nutrients essential to growth and developments (Ballew *et al.*, 2000). This scenario can be seen in the control group in which there was increased frequency of sugary foods and drinks intake and low reduction for only certain types of sugary foods and drinks intake. In fact, the fruits and cariostatic foods intake was lower compared to intervention group. Low-nutrient-dense foods not only cause dental caries but also correlate with many chronic health problems in both developing nations and developed parts of the world (Kant, 2003; Ballew *et al.*, 2000).

In summary, the TIPTOP program had a positive impact on food quality by decreasing the frequency of consumption of sugary foods and drinks as well as increased fruits and cariostatic foods intake in the intervention group. In addition, decreased and delayed consumption of foodstuffs with high sugar density and a lower frequency of meals and snacks at an early age was the possible mechanism to explain the lower caries experience of toddlers in the intervention group. On the other hand, in the control group, the opposite happened ie. There was increased in frequency of sugary foods and drinks consumption and decreased fruits intake as well as cariostatic food.

5.2.3.2.4 Impact of TIPTOP program in improving Knowledge, Attitude, and Practices (K/A/P).

The previous sections have documented changes in ECC, diet and nutrition habits between intervention and control group. But are there any change in knowledge, attitudes and behaviour through the education programs implemented in the TIPTOP package targeted at mothers?

In general, there was an improvement in knowledge, attitude and practices of mothers who received the TIPTOP package. At the beginning of the study (baseline), all mothers in both groups were at the same level of K/A/P scores ($p>0.05$). While after 18 months of intervention period, there were significant increase of knowledge, attitude and practices scores of mothers in the intervention group as compared to the control group ($p<0.05$).

After being exposed to the TIPTOP package, the majority of mothers had high knowledge of nutrition and oral health with increased knowledge scores of about 30% between pre- and post-intervention. The increment of knowledge scores in the present study was double compared to a study done by Andrea *et al.*, (2010) in their study on the impact of community workshop in improving early childhood oral health knowledge where the increment was 16% at post intervention. In fact, in the intervention group, mothers with high “attitude” scores increased by about 20%, followed by high “practice” scores which increased about 25%.

As noted, oral health related behavior is important for identifying targets for preventive oral health programs at individual and community level (Petersen *et al.*, 2004). Zhu *et al.*, (2003), reported that the reduction of dental caries and changing oral disease patterns in the past decades were parallel with significant improvements in oral health awareness, dental knowledge and attitudes of children and parents and behavior is modifiable and provides addressable factors for health promotion efforts.

Compared to other intervention studies, behavioral changes have been shown to be successful in altering intermediate outcomes such as parent's cognition, hygiene and feeding practices but not in reducing the incidence of dental caries (Petersen *et al.*, 2004; Vachirarojpisan *et al.*, 2005; Kramer *et al.*, 2007). However, in another intervention study done by Weinstein *et al.*, (2006), they found a lower incidence of ECC among children whose parents had been given advice, from 6 to 18 months on feeding, oral hygiene and fluoride use with significant changes of behavior among parents. In addition, Plutzer & Spencer (2008) reported a major reduction in the incidence of severe ECC with a program anticipatory guidance about oral hygiene and nutrition during the index pregnancy and further counseling when the child reached 6 to 12 months of age.

However in the control group, all the mothers was at the same level of knowledge at pre- and post intervention and only showed a small increment of attitude score ($p>0.05$) at post intervention. In fact, there was some reduction or worse practices score among mothers ($p<0.05$) after 18 months of study period compared to the baseline.

We concluded that the impact of the TIPTOP program have produced more mothers with high scores of knowledge, attitude and practices of nutrition and oral health and no mothers with low score of knowledge, attitude and practices at post intervention as compared to the control group.

What were the individual components of the TIPTOP program that contributed to such wide ranging improvements as compared to the standard MOH toddlers program? The following table (Table 5.1) summarizes the differences and our comments. It should be noted that the TIPTOP program may be divided into several components presented as a package but may be individualized for those at high risk. The components are: (a) Health Center Visit Activity, (b) Nutrition and Diet Education,

(c) Oral Health Education and Oral Health Maintenance Skills, (d) Positive Reinforcements component viz. digital photo records, tokens and travel allowance, SMS reminder service and home visits for identified high risk individuals. The next section (Section 5.3) will discuss the possible explanations for the success (or failure) of each component of the TIPTOP program.

5.3 Application of PRECEDE PROCEED Model in controlling early childhood caries, nutritional status, dietary habits and mothers K/A/P.

In the present study, after evaluating the potential use of several alternative health education planning models, this research decided to adapt the PRECEDE PROCEED model to assess the effectiveness of the health promotion intervention program (ie. TIPTOP Program) for improving oral health (ie. Early childhood caries) and general health (ie. nutritional status, nutrients intake, sugary foods and drinks intake and K/A/P). According to Green & Kreuter, (1999), PRECEDE PROCEED model is a diagnostic approach to health education planning, which is used to guide the planning and process evaluation of the project and it has 9 phases.

A). PRECEDE consist of five assessment phases:

1. Social assessment phase.

This phase is performed to help the target population (ie. Toddlers) identify their needs, wants, resources and desired quality of life. Mothers or caregivers were involved and empowered to improve their toddlers level of oral health (ie. prevent early childhood caries) and general health (nutritional status and dietary habits and mothers K/A/P). In this phase, a smart partnership was formed between major stakeholders ie. (a) mothers, (b) a nutritionist to discuss the purpose, objectives, times, strategies and information related to nutrition, as well as general health (nutritional status, dietary

habits and mothers K/A/P) and (c) dentists to assess the caries status of toddlers and dental nurses to assist in implementation of the intervention phase.

2. Epidemiological assessment phase.

An Oral Health Division, Ministry of Health, Malaysia (2007) report, showed that the prevalence of ECC among 5 year old preschool children was 76.2%. In Pasir Mas, Kelantan only 0.4 % of children aged 4 to 6 years were caries-free and each child had on average 12 teeth affected by ECC (Badariah, 2005). As pointed by Jaafar *et al*, (1992), delay in getting treatment for dental caries is a common and serious problem in Malaysia and most patients only visited for emergency reasons (Taani, 2002a). In order to confirm or refute the present caries scenario in our research, a proxy study on 5-6 year olds in Pasir Mas and Tumpat districts were done.

3. Behavioral and environment assessment.

This phase focused on systematic identification of ECC and others related factors which appear to be linked to identify the problems among preschool children (proxy population). During this phase, the researcher assessed the mother knowledge, attitude and practices in nutrition and oral health towards their preschool children. Other information including dietary habits and sugary foods and drinks of preschool children were also observed. The researcher found that one-half of mothers in the proxy population scored in the “*moderate*” category in knowledge, attitude and practices. Preschool children were observed to have unhealthy behaviors related to dietary intake especially sugar intake where the consumption was three times higher than the WHO (2003) recommendation. The frequency of consumption of sugary foods and drinks was high especially Milo, sweets and ice-cream.

4. Educational & Ecological assessment phase.

The purpose of this phase was to identify predisposing, reinforcing and enabling factors that increase the probability that the behavior and environment change will occur.

a) Predisposing factors

These include the individual's factors (mother) that influences the preschool children behavior such as knowledge to guide food choices, attitudes about oral health and practices related to personnel preferences and existing skills related to oral health. During the analysis of predisposing factors in the proxy population, the researcher observed that majority of mothers have *moderate* knowledge, nearly 40% have *low* attitude and more than one half scored *moderate* practices related to nutrition and oral health.

b) Reinforcing factors

The reinforcing factors include factors that reward or reinforce and motivate to continue healthy behavior such as social support, praise, direct benefits and reinforcing behaviors which can be delivered by the researcher, family, friends, peers and others who controlled the rewards. In this study, reinforcing factors were continual reward ie. RM20.00 for every visit which was given to the parents as incentive to cover travel costs as well as gift tokens. In addition, SMS and e-mail reminders to parents about the importance of daily oral health care as well as to remind them to control the consumption of sugary foods and drinks.

Other reinforcing factors were photo records of the maxillary incisors where every toddler can easily see and monitor their own caries development by comparing the photo record in a time-series ie every six months. In terms of motivation, all the

mothers received diet counseling in a group setting to encourage peer-to-peer support and sharing of experience and also in individual settings to reinforce behaviour changes in balanced diet according to Malaysian Recommended Nutrient Intake.

c) Enabling factors

Enabling factors are psychological/emotional or physical factors that facilitate motivation to change behavior. During this phase, the researcher assessed diet counseling either in individually or in a group. The consultation given by the nutritionist is hoped to be the enabling factor that may change the dietary intake patterns among toddlers in order to control the early childhood caries as well as improve their nutritional status and dietary habits.

5. Administrative & Policy assessment

This phase focused on the administrative policies which must be addressed prior to oral health promotion and prevention program implementation. During this phase, the implementation of oral health care group activities ie. Proper brushing techniques to toddlers and preschool children was introduced and maintained in order to prevent dental caries. All sweets foods and drinks intake should be controlled especially in the TADIKA and at home.

B) PROCEED phase:

6. Implementation phase.

For this phase, the researcher developed the most appropriate methods and strategies of the intervention program according to the data and observations made in the earlier phases. Generally, the TIPTOP program was scheduled every six months, in order to be practical and cost effective. However, for special high-risk individuals shorter intervention intervals were implemented.

7. Process Evaluation

Process evaluation involved any combination of measurement procedures obtained during the implementation of TIPTOP. The cost effectiveness of the program depends on the practicality and ease of implementation in terms of manpower, money and materials needed. Ideally the process of implementation should be as cheap as possible, easily done but with maximum benefit to ensure that the TIPTOP program is practical and sustainable in the long term.

8. Impact Evaluation

This phase focused on evaluation after 18 months of TIPTOP on toddlers leading to the intended outcomes of the program. In this program, caries free children in the intervention group was higher (37.5%) compared to the control group (19.5%). The nutrition indicators showed that three-quarters of toddlers had normal of WAZ in intervention group as compared to only one-half in control group. More than three-quarters had normal of HAZ in intervention group, compared to only 34.1% in control group. Furthermore the majority was normal of BMI-for-age in intervention compared to control group (only 61%). Most of the nutrient intake improved in intervention group

but less or no change in control group. Majority of sugary foods and drinks had been reduced in intervention group while only a small percentage reduction occurred in control group. For K/A/P of mothers, majority mothers had high knowledge, attitude and practices in intervention group while the reverse was true in control group. It's showed that TIPTOP program was successful not only in controlling early childhood caries but also general health in particular WAZ, HAZ and BMI-for-age and also nutrients intake and reduced the sugary foods and drinks consumption among toddlers.

5.4 The strength of TIPTOP program versus Existing MOH Toddlers program.

The strength of the TIPTOP program lies in the package of diverse approaches that was used which was thought to be most appropriate and practical for this population, bearing in mind their low socio-economic status and rural population. The individual components was formulated during brainstorming sessions between the principle investigator, coworkers and feedback from many sources following the PRECEDE-PROCEED framework discussed earlier. The following discussion highlights the strength of the individual components.

First, the number of visits for all toddlers in the intervention group was set at a minimum of four visits at the health clinic or "*Klinik Desa*" during the 18 months duration of study, which comes to an average of once every six months (compared to once a year in the usual toddlers program). While, for those who showed early signs of ECC on the central incisors after the first baseline visit, home visits was performed by the researcher and a dental nurse once a month. This is because at least one study have showed the effectiveness of home visit which resulted in a significantly lower caries experience for the intervention group who received home visit dietary advise with the odds of 0.52 compared to a control group (Feldens, 2007). Toothbrush and toothpaste were given to the child during every intervention session as a form of motivation and

reward for compliance. The trained dental nurse reinforced the oral health messages given earlier especially daily oral hygiene and followed by a practical toothbrushing session. The photos of anterior teeth taken earlier was shown to the mothers and compared to the existing state of incisors and for discussion and for visual reinforcement and motivation. We think that the home visits were effective because there was more time for the parents to interact and ask questions. The messages were also tailor made to the actual problems faced by the parents at home. Thus it was very personalized.

Second, the method of delivery of nutrition information was through a “CD” which was played on a LCD projector with a short timing of 10 minutes. Due to the short period, it was observed that the paired mother and child were not bored and it was more attractive especially to the children compared to a lengthy talk given by health personnel. This was based on the findings of other studies that in the Malaysian population, the mass media (TV, newspapers) or multimedia is currently the most acceptable mode of transmission of health messages (Abu Salleh *et al.*, 2005).

Third, to support and reinforce the visual information from the CD/LCD multimedia show, on nutrition and ECC; all mothers also received four coloured pamphlets on different topics as hardcopies to be read at leisure. The same method was used in the intervention study to reduce ECC in Southern Brazil as reported by Feldens *et al.*, (2007).

Fourth, the message content was never compartmentalized to dental, oral or nutrition per se. The subsequent diet counseling question and answer session and home visit reinforcements was used to explain to all mothers to emphasize balanced diet following the Malaysia Recommendation of Nutrient Intake (NCCFN, 2005), the food pyramid for selection and frequency of food intake and its influence on ECC control. All mothers were advised not to use bottle feed drinks or pacifiers and they were

encouraged to wean off bottle or breast feeding during the night. This was because for children over two years old, these habits should have been stopped. The mothers were also advised against adding sugars (including sugar cane or honey) in porridge, juices, milk or other liquids and control soft drinks, sweets and sugary snacks to mealtimes; they were encouraged to avoid fried food and to use salt in moderation. The mothers also received verbal and written information about preparation of alternative healthy food and recipes suitable for the child's age, and traditionally used by families in this region (Kelantan).

Fifth, the messages were simplified and practical. For example, the household measurement used in the health education activity was simplified by referring to a cup, glass, plate, teaspoon, tablespoon, bowl etc comparative to the amount needed to ensure adequate food and nutrients intake among children to prevent ECC as well as to promote good general health. Local alternative foods which were safer for teeth like savoury snacks (eg keropok, keropok lekor, kacang etc) instead of cheese which are rarely seen here. This may be the first attempt to integrate diet and nutrition education by a nutritionist (the principal investigator) and dental professionals (dental co-workers) in health center setting as well as home visits. The present study corroborated what was reported by Feldens *et al.*, (2010), who found that home visits with dietary advice and diet counseling at an early age reduced the incidence of early and severe ECC by 22% and 32% respectively; resulting on average, in approximately one less tooth affected by caries per child at age 4 years.

Sixth, the photo record used in the TIPTOP intervention was an innovative method used in health promotion and health education to help prevent ECC. At every visits or home visit, a digital photographic record using an SLR digital camera on macro shooting mode was made on the central maxillary incisors of every toddler. This was because the maxillary incisors were the most affected carious teeth in young children

(Ismail, 1999) and accounted for 98.5% of all caries identified in the study in Brazil (Feldens *et al.*, 2007). Every photo was printed in duplicate in which one was given to the mothers as health education motivation at home to educate their children via the image (ie. looked good or bad) and one was kept by the researcher in the patient's folder for future reference at the next visit to monitor the caries progress. The minimum standard for acceptable digital photography was tried and tested (Refer to Material and Method Section).

It was easy to do. It did not require complicated professional skills. The current digital camera technology has improved by leaps and bounds and now very accessible and affordable to almost everyone. Being digital, the images can be stored easily in computers, thumb drives, external hard disks, and emailed or SMS'ed to the patient whenever needed. It can also be projected on screen for the patient during counseling. The possibilities of using digital images are endless provided the level of internet penetration in rural areas can be improved. The government transformation plan in ICT in the next ten years if successful will make this a reality. However at present, the SMS is the most viable alternative.

Seventh, the SMS reminder service is another innovative method tried in the present study. Every mother involved in the TIPTOP program received reminders in the form of "SMS" in order to remind them to implement tooth brushing and control sugary foods and drinks and give more fruits and vegetables to their children. The SMS were sent to mothers almost every week. Examples of "SMS" messages were as listed below.

Table 5.1 Examples of “SMS’ messages.

SMS message (Malay)	SMS message (English translation)
“ <i>Jangan lupa gosok gigi anak anda setiap hari</i> ”,	Dont forget to brush your child’s teeth everyday
“ <i>Jangan beri makanan manis kepada anak anda</i> ”,	Avoid giving sugary sweet foods to your child
“ <i>Buah-buahan dan sayuran baik untuk kesihatan, beri pada anak anda</i> ”,	Fruits and vegetables are good for your child’s health
“ <i>Kacang, susu, keju, keropok, yogurt bagus untuk gigi anak anda</i> ”.	Nuts, milk, cheese, <i>keropok</i> , plain yogurt are good for your child’s teeth.

The value and impact of constant reminders through SMS cannot be underestimated. Although at the beginning we doubted many poor families would have mobile phones, we were proven wrong. In the present scenario of cheap mobile phones that are so ubiquitous, almost all rural families in the present study has one. It has become a necessity. Thus health education must make use of the potential of existing technology. At 20 sen per SMS, it provided the quickest and cheapest way to send reminder health messages at any time compared to face-to-face meetings. It was very successful because most would also respond with return SMS replies. In future, we recommend the use of social networks such as tweeter, emails, chats, etc to widen the distribution channels of healthy messages at low cost to high risk populations. The Ministry of Health should develop and adopt the use of new social media in its health promotion strategies.

Eighth, cash incentives for health center visits were given. As we know, the majority of respondents are poor and live quite far from the health center clinic, so to encourage mothers to attend the toddlers health intervention program, monetary incentive as a positive reinforcement was implemented in the TIPTOP program. However the incentive was just enough to cover travel and meal costs. Every mother received money amounting to RM20.00 at every visit. During the home visits healthy alternative snacks like “*keropok*” (local fish crackers) was given. As reported by Edwards et al, (2002), use of incentives and reminder was an effective means of improving response rates in a systemic review. To ensure the TIPTOP program does not burden the participants; the actual time spent was short which is about one hour for entire visit. Although short, it gave a rare opportunity for the health promoter to observe first hand and understand the challenges faced by the respondents in implementing their health recommendations.

In contrast, the pair of mothers and toddlers in the control group received only two visits at the health clinic (or “*klinik desa*”) at the beginning and at the end of program, following the usual once yearly toddler program frequency and no home visits. Thus, individualized diet and nutrition counseling was not done here. They received the standard nutrition education and oral health education following the current syllabus of Oral Health Division MOH, conducted by trained dental nurses. There was also no SMS Reminder Service or periodic photo records, except for baseline and end of program photos, in the control group. However, every mother in the control group received the travel and meal expenses of RM20.00 per visit for two visits throughout the study to avoid systematic bias.

Thus we conclude that the positive results seen in the intervention group were due to the overall intervention as a package rather than any individual intervention

component. Each component reinforced and supported one another at different times in different ways.

5.5 Weakness of this program

Despite the strength mentioned above, a few weaknesses and limitations were also observed. First, it was difficult to stick to a schedule as planned due to the unforeseen circumstances. Although all the visits at the health clinics has been planned much earlier but it may clash with other program at the health clinics. So the intervention can only be done in between other activities which may result in less than ideal spacing of time.

Second, the intervention program had to be postponed at many health clinics due to severe floods which occurred yearly in December in Kelantan which prevented the mothers from bringing the toddlers to the clinic for the intervention. There were further delay in terms of communication and meeting between researcher and participants. Incidentally, the floods also increased the need for intervention in oral health, diet and nutrition where generally general and oral hygiene measures were at their lowest due to the difficult conditions. Clean water to drink, cook, bathe and brush their teeth is scarce during floods which may last for weeks.

Although the TIPTOP package were conducted at the health clinic as a routine for mothers to bring the child for regularly check-up, not all the participants attended the scheduled appointments. Sometimes the principal investigator had to rush through the counseling sessions since those waiting had to go back to work and thus less time was spent with them (mothers and child). The researcher's time was also wasted when the participants did not turn up for their appointment on time. Certain mothers also brought other children during the intervention session, this situation caused the mother's

focus to be interrupted. However this the reality in all community based programs and the health service have to be ready to face it.

Finally, the environmental support was not adequate to facilitate, maintain or reinforce the behaviour change of individuals. For example, the availability of unhealthy snacks and sweet drinks sold in the clinic and shops selling cheap high-energy, low-nutrient-dense foods are everywhere, poor social support, especially from siblings and immediate family members who frequently offer unhealthy snacks as rewards to participants which made the dietary recommendation difficult to implement. These were some of the informal grouses stated by mothers who said they was not much they can do about it. To make matters worse, the government policy in the form of sugar subsidies may help to reduce the cost of living in the poor population but the cost to health and oral health is apparent as illustrated in the deplorable oral health status.

5.6 Other limitations of the study

Although sample size estimated for Phase two and three of the study was 64 children in each group, the final sample size of both intervention and control group was smaller at about 40 pairs of children and their mothers. However, nothing else could be done to increase the sample number because all eligible samples at baseline in both districts have been recruited. This showed that ECC was so rampant that it was not possible to find any more toddlers with no caries at two years old. Although statistically this was adequate for a longitudinal intervention study, practically there was no other alternative because it was just impossible to find any more children without caries at two years old. This was the sad part of the situation. We envisaged that we could get many two year old caries-free residents with a target of 60 toddlers per group. But the situation proved otherwise. Rampant caries was occurring as early as below two years of age. In the proxy population of 5-6 years old, the prevalence had reached at alarming

98%. Therefore we propose that toddler ECC be declared a national priority in support of better nutrition and diet policies. Nevertheless, we do recognize that having less sample may affect power of the study. In this study, the significant differences between intervention and control group were still able to be detected perhaps due to the large difference in the outcomes between these two groups.

Multivariate analysis was not performed because there were multi outcomes in this study which may complicate the analysis and furthermore, the socio demographic characteristics were not significantly different between intervention and control groups. However, we recognized that other potential extraneous variable may affect the results but steps had been taken to ensure all known confounders have been controlled.