

Oral health status and behaviours of children in rural districts of Cambodia

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Abstract

Objective: *The aims of the study were to describe the caries and periodontal status of children in rural Cambodia and to study their oral health habits.*

Method: *Field examinations were conducted in Pailin, Kampong Thom and Kratie which are three rural districts in Cambodia. Children aged 6 and aged 12 were selected for report of caries status of primary and permanent teeth respectively. The periodontal status of the 12-year-old children in Kampong Thom and Kratie were assessed. A parental questionnaire survey was performed to study the children's tooth brushing habits, snacks habits and their diet.*

Results: *A total of 120 6-year-old children and 196 12-year-old children were examined. The caries experience (dmft) of the 6-year-old children was 7.9 ± 5.6 . The caries experience (DMFT) of the 12-year-old children was 1.1 ± 1.6 and all were untreated caries (DT). None of the surveyed 12-year-old children had healthy gums and 62% had calculus. A total of 316 questionnaires were collected. The result found 44% and 22% of the 6- and 12- year-old children had never brushed. Their meals were all mainly rice, soup and congee and snacks were not common.*

Conclusion: *The caries experience of the 6-year-old children was high and most of the caries were untreated. The 12-year-old children had a mean of 1.1 caries in their permanent teeth. They all had bleeding gums and more than half had calculus. Their oral health habits need to improve as many children never brushed their teeth. (239 words)*

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Introduction

The Kingdom of Cambodia is situated on the Indochina Peninsula with an area of about 181,035 sq km and has borders with Thailand, Laos and Viet Nam. It is a country recovering from decades of conflict, which has left it one of the poorest countries in the world¹. According to the National Institute of Statistics of Cambodia, the population of Cambodia in 2006 was approximately 14 million with more than fifty percent under twenty years². The World Bank's World Development Indicator showed that Cambodia is in the midst of the nations with very low income per capita³. The gross national product (GNP) per capita was about US\$ 300 in 2003⁴. Many people live in extreme poverty on less than US\$1 a day. Some 85% of Cambodia's population live in rural areas, and about 75% are engaged in subsistence farming. Only 29% of the population has access to safe drinking water, 15% to electricity and 9% to sanitation. Some 30% of the population faces chronic food shortages.

Although there are serious efforts being made to re-develop Cambodia on all fronts, war has left the country with little in the way of infrastructure and with one of the poorest health systems in the world. Much of the health care is therefore provided outside of the government system. Dentistry is one area that has been largely neglected over the past 30 years, even though many Cambodians suffer from dental problems⁴. Despite the limited resources for dental health and inadequate dental personnel, efforts are now being made to improve oral health education and services in Cambodia.

The number of dentists working in Cambodia is very limited and was about 400 in 2006⁴. The dentist population ratio is therefore about 1:33,000. Most of the dentists work in the capital for a better income. There are about 320 dental nurses (primary oral health care

workers) who were trained at the Regional Training Centre in Kampong Cham to provide basic oral care for people at health centers in rural areas. In addition, there are about 300 unqualified ‘dentists’ also practicing dentistry. These are the traditional practitioners who practice dentistry techniques passed down from father to son in an apprenticeship system⁵. A survey found one third of the people received treatment from a traditional dentist⁶. The dental workforce is far below that required to meet the demands of the country’s population⁷.

The national university in Phnom Penh trains dentists with a DDS degree to serve the community. The length of curriculum is 7 years and about 60 dentists graduate each year. In addition, there is a school for dental nurses accepting 25 students per year. The dental nurses training programme aims to allow better access for rural people to basic preventive and curative dental care, and at a cost which the country can afford. It takes about 9 months for a certificate and 1 year for a diploma. The dental nurses are trained to provide simple treatment, including local anaesthetic, extractions, atraumatic restorative technique (ART) restorations, and scaling, for all age groups. They also learn how to introduce prevention and oral health promotion activities within their communities. Evaluation has shown the programme is meeting the oral health needs of the rural people where there were no dentists⁸.

Epidemiological surveys in Cambodia are few. A national oral health survey was carried out in Cambodia in 1990-1991⁹. In Phnom Penh the caries rate among the children was reported to be high. The caries experience of the 6-years old and the 12-years old as measured by the dmft and DMFT were 9.0 and 3.2 respectively. Another study performed in 2002 investigated 239 12 year-old school children of the in Phnom Penh and found a mean DMFT of 2.3¹⁰. However few studies have been carried out in rural areas. Since the majority of children are living in such locations and their living standards are in general inferior to those in the capital, it is likely that they have a different oral health profile.. Thus, studies to

describe caries status of the children in rural Cambodia can provide useful information for planning oral health services. The purpose of this article is to describe the caries status of the primary dentition in 6 years old children and caries and periodontal status of the permanent dentition in 12 years old children in three rural areas of the Kingdom of Cambodia.

Method

Selection of study locations

This study reports on three surveys carried out during missionary dental services in rural areas, Krong Pailin, Kampong Thom and Kratie.

Krong Pailin - The survey in Krong Pailin was carried out in August 2003 when the Alliance Global Serve Hong Kong sent a dental missionary team to provide treatment for the children in two villages O Ta Prang and Bahuy Khmer Cheung. The service included an assessment of the village children's oral health status, their diet and dental habits. A field examination was conducted using sickle probe and front surface dental mirror under natural light in open area by a dentist experienced in survey methodology. All children were invited for an oral examination and children aged 6 and 12 were selected for report of caries status of primary and permanent teeth respectively. The caries status of 6 and 12 years old children was assessed by the dmft and DMFT as described by the World Health Organisation (WHO) in 1997¹¹. A parental questionnaire survey was carried out to investigate the children's tooth brushing habits, use of fluoride toothpaste, snacks habits and their food intake on the previous day. The questions were translated and read in Khmer language to parents of the children by three local Cambodian Bible seminary students. The responses from parents were clarified and recorded by the students. Samples of available toothpastes were purchased by the local missionary staff from grocery stores and local markets. The respondents were asked to identify which toothpaste they were using.

Kampong Thom - The survey in Kampong Thom was performed in September 2006 when the Chinese Rhenish Church Hong Kong Synod Mission sent a dental missionary team to provide dental treatment for the children there. The service included an assessment of the local children's oral health status, their diet and dental habits. Field examinations were conducted at a local church in Phum Thmey and at a primary school in Pong Teak Village using CPI probe and front surface dental mirror under natural light in open area by two experienced dentists; one was the examiner for the survey in Pailin. All children aged below 15 were invited for an oral examination and children aged 6 and aged 12 were selected for report of caries status of primary and permanent teeth respectively. The caries experience of 6 and 12 year old children was assessed by the dmft and DMFT respectively and the periodontal status of the 12 years old children was assessed by Community Periodontal Index (CPI) as described by the WHO in 1997¹¹. A calibration exercise was performed by the two examiners before the survey. About ten percent of the examined children were re-examined and the inter-examiner agreement was assessed by Cohen's Kappa statistics. The same parental questionnaire used in Pailin was used to study the children's tooth brushing habits, use of fluoride toothpaste, snacks habits and their diet on the previous day. The questions were read in Khmer language by two local Cambodian Bible seminary students. The responses were clarified and recorded by the students. Samples of available toothpastes were purchased by the local missionary staff from grocery stores and local markets. The respondents were asked to identify the toothpaste they were using.

Kratie - The survey of children in Kratie was conducted in July 2007 during the oral health education program provided by a dental missionary team of the Alliance Global Serve Hong Kong. Like the previous events in Pailin and Kampong Thom, the program included an assessment of the local children's oral health status, their diet and dental habits. Field

examination was conducted at a local mission house in Kratie using CPI probe and front surface dental mirror under natural light in open area by the same experienced dentist who carried out the surveys in Pailin and Kampong Thom. All children aged below 16 were invited for the oral health education and an oral examination was provided to children aged 6 and aged 12. The caries experience of 6 and 12 year old children was assessed by the dmft and DMFT respectively and the periodontal status of the 12 years old children was assessed by CPI. The same parental questionnaire was used to study the children's tooth brushing habits, use of fluoride toothpaste, snacks habits and their diet. The questions were asked in Khmer language by two local Cambodian helpers who recorded the answers. Samples of available toothpastes were purchased from local grocery stores in market. The respondents were asked to identify the toothpaste they were using.

Results

In Krong Pailin, 23 six-year-old children and 59 twelve-year-old children were examined. In Kampong Thom, 59 six-year-old children and 79 twelve-year-old children were examined (Table 1 and Table 2). In Kratie, 38 six-year-old children and 58 twelve-year-old children were examined. Hence, a total of 120 six-year-old children and 196 twelve-year-old children were included in the survey. No children came and refused the examination in all these surveys. The inter-examiner agreements were 0.93 and 0.74 in tooth and periodontal assessment respectively.

Among the 120 six-year-old children examined, there were 11 children, 3 boys and 8 girls, with no caries experience (zero dmft) in their primary teeth (Table 3). The difference was not statistically significant. The overall caries experience as measured by mean dmft was 7.9 ± 5.6 . The boy's caries experience was higher than that of the girls (8.8 vs. 6.9); however, the difference was not statistically significant. Thirty eight percent of the children had caries on

at least half of all their primary teeth. Three children had untreated dental caries in all their 20 primary teeth. There were 14 children with missing teeth due to caries and a total of 24 primary teeth were lost due to decay. No fillings were found in any of the primary teeth of the children examined.

The caries experience of the 196 twelve-year-old children as measured by mean DMFT was 1.1 ± 1.6 (Table 4). The mean DMFT for girls was 1.2 ± 1.5 and for boys was 1.0 ± 1.8 . There were 102 (52%) twelve-year-old children who had no caries experience. The proportion of children with no caries experience (zero DMFT) for the boys and the girls was 62% and 46%; and the difference is statistically significant ($P=0.04$). There were 33 (8%) children with three or more carious teeth. The maximum number of decayed permanent teeth found in a child was 8 and there were 2 children with 8 carious teeth. No permanent tooth had been lost due to caries and no restorations were present in any of the children.

The periodontal assessment found that none of the surveyed 79 twelve-year-old children had healthy gums (Table 5). More than 60% of the children had calculus and the mean number of sextants with calculus was 2.3 ± 2.3 . There was no statistically significant difference in the distribution of the highest CPI scores between the boys and girls.

Among the 312 6- and 12-years old children, 98 children (31%) never brushed, 37 (12%) reported they brushed occasionally and 178 (57%) brushed at least once a day. The tooth brushing habit, use of fluoride toothpaste and snack consumption of the six- and twelve-year-old rural Cambodia children are shown in Table 6. For the six-year old children, it was found that 44% never brushed and 49% brushed their teeth at least once a day. There was no significant difference between the brushing habits between the boys and the girls. The majority of children who brushed used fluoride toothpaste and 17 children used non-fluoride

herbal toothpastes. Rice, soup, congee and vegetables were their main foods. Snacks were not common and only 13 (11%) of the children had consumed snacks the day before. The snacks were mainly sweets, and two had fruit juice.

For the 12-year old children, it was found more than half (63%) brushed their teeth at least once a day. However, 22% of the children never brushed their teeth. There were significantly more girls than boys who brushed at least once a day ($p < 0.02$). The majority of children who brushed used fluoride toothpaste and 39 children (20%) used non-fluoride herbal toothpaste. Again rice, soup, congee, and vegetables were their main food. Snacks were not common and only 14 (7%) of the children had consumed a snack food the day before. The snacks were mainly sweets; three had coffee and two had fruit juice.

A search of the toothpastes available in the local markets showed there were 18 toothpastes found in Pailin, 23 in Kampong Thom and 17 in Kratie. Among them, three in Pailin and four in Kampong Thom were non-fluoride toothpastes imported from China or South Korea. The common sizes of the toothpastes were 50 grams and 200 grams. They cost from about fifty cents to less than two US dollars per tube and in general cost about US dollar per 100 grams. All of them were imported products and 14 claimed to contain fluoride; of the remaining four was a herbal toothpaste imported from China and three were imported from South Korea. Overall 52% of the children used fluoride toothpaste, 17% non-fluoride toothpaste and 31% did not brush.

Discussion

This study reported on the oral health status of children living in three economically deprived rural areas of Cambodia. The present sample surveyed was by no means a random sample of the children in rural Cambodia because of the convenient sampling protocol and the

requirement of the survey to dovetail with the voluntary dental service. For the same reason, it is not to describe as a point prevalence study but is from 2003-2007. However, the three sites for the survey are typical examples of rural areas in the Kingdom of Cambodia. Krong Pailin has an area of 803 km² located on the western part of the country next to the border of Thailand. Pailin is classified as a municipality and it has a population of about 34,000². It is about 300 kilo-meters northwest to the national capital. As the last base of the Khmer Rouge, it is inhabited mainly by former Khmer Rouge rebels and their families. It became an autonomous district in 1996 when the Khmer Rouge there decided to lay down their weapons. Kampong Thom is about 150 kilo-meters north to the national capital. It lies along the Sên River and is linked to Phnom Penh by national highway routes. It has a population about 695,000². Kampong Thom is one of the areas in Cambodia most heavily affected by the years of war. It is one of the poorest provinces with the highest level of food insecurity in the country. Ninety percent of the population face several months each year without sufficient rice¹². Kratie is located in the northeast of Cambodia and is about 200 kilo-meters northeast to the national capital. The province is bisected North-South by the Mekong River and its narrow floodplains. It borders Vietnam to the South and Kampong Thom to the West. The population was about 325,000 and the population density of the province is 29 persons/km² compared to an average population density for Cambodia of 75 persons/km². Household incomes are low for many households, who live below the consumption poverty line. Sources of income are often low return, erratic and insecure economic activities within the informal sector of the economy.

The caries diagnosis was in cavitation level. This basic diagnostic level allows a high level of reliability and was reflected in the good inter-examiner agreement. Though a sickle probe was used in Pailin and a CPI periodontal probe was used at Kampong Thom and Kratie, the precision in caries diagnosis would be very similar as probing into the cavity was not

common. However, periodontal assessment could not be performed with sickle probe and therefore it was not performed in the children in Pailin. This reduces the sample size of the children from 196 to 137. Nevertheless, the number is considered adequate to draw a conclusion.

This survey found that the overwhelming majority (91%) of the six-year-old children had experienced caries and these carious lesions were left untreated. The caries experience in primary teeth of the children was very high (dmft=7.9). Dental abscesses were commonly observed during the surveys. Such caries can cause pain, swelling and local infections, and can adversely affect the development of the permanent teeth. Spread of the infection can cause serious complications such as toxemia, fever, cellulitis and even airway obstruction. The American Dental Association released a statement on the importance dental treatment on March, 2nd 2007 after the death of a 12-year-old child¹³. He died of a brain infection from a dental abscess in the US on February 25, 2007¹⁴.

The oral hygiene practices of the children in this study were generally poor as the majority of the children reported they did not brush daily and many of them had never brushed. The caries experience and the prevalence of caries in primary dentition of boys were higher than that of the girls, and this might be due to the finding that more girls brushed their teeth than boys. Compared with the caries prevalence of children in rural areas in nearby countries such as China and Thailand, the caries prevalence and severity of the six-year old children was higher in Cambodia^{15,16}.

The Cambodian National Oral Health Survey (1990-1991) was conducted in Phnom Penh and six provinces and found that the permanent tooth caries experience of the twelve-year-old children was 1.6. The caries experience of children in Phnom Penh was 3.2. Among them

94% of the DMFT was untreated caries and 6% was missing teeth due to caries. A more recent survey in 2003 reported that the caries experience of the twelve-year-old children living in the capital Phnom Penh was 2.3¹⁰. In agreement with studies from other countries, this study found a lower caries experience of children in rural areas, compared with more urban areas such as Phnom Penh^{15,17}. No dental restorations were found in any of the examined children, a finding supported by previous reports^{18,19}. The caries experience in permanent teeth of the 12-year-old girls was higher than that of the boys, and there were significantly more girls with dental caries than boys. Other studies have also found this difference which might be due to the earlier development and eruption of permanent teeth in girls^{17,20,21}. Tooth brushing was not widely and regularly practiced in these children, although the caries experience of permanent teeth was low. The finding of a low dental caries experience in the present study agreed with a previous survey in Cambodia¹⁸ and is similar to other rural, economically deprived populations in neighboring countries such as Thailand and China^{15,17}. This lower caries experience might partly be due to a low consumption of sweets and candies. Poor families cannot afford to buy many sweet snacks and maintain a more traditional diet which is low in sugar²². However, there have been many changes in Cambodian communities in recent years. Snacks are becoming more available and the family incomes are increasing, and it is likely that the caries rate of the children will rise. This could become a significant health problem for the country because dental treatment services are not readily available. Therefore, strategies to promote oral health and prevent dental caries must be introduced. These should include oral health education on tooth brushing and limiting cariogenic snacks. A past dental health education program organized by dental students was well received by Cambodian children²³.

In 1993 a 4-5 month program to train rural dental nurses was introduced and later extended to 9-12 months. Initially courses were conducted in 12 of the Cambodia's 22 provinces, but

in 1997 a dental nurse school was established in Kampong Cham⁸. There is no data on how many of the present about 400 dental nurses would stay in the rural provinces, as they would earn more in urban areas. Atraumatic restorative treatment (ART) of caries is now being performed by these nurses throughout Cambodia²⁴, although the present survey did not find any filling in any of the surveyed children. It seems that the small number of dental nurses cannot meet the high demand of the children with caries. Few dentists work in rural areas, it is therefore the dental nurses who have the most potential to provide children with basic dental care. Although ART is a cost-effective simple restorative technique for restoring decayed teeth, some have suggested that it as an expensive and time consuming approach for Cambodia²⁴. Other strategies to address the caries problem which are simpler and lower in cost should be considered. Use of fluoride agents and tooth brushing programs can be used to arrest caries development. For example, silver diamine fluoride (SDF) treatment is a low cost, simple and fast treatment in arresting caries^{25,26}. It can be an appropriate way to deal treat caries in poor communities with high caries prevalence. An added advantage in using SDF is its low risk of cross infection, which is very important in a country with a high prevalence of HIV/AIDS and hepatitis B and C²⁷.

While the Cambodian government has received a water prize for providing safe drinking water to a million people in Cambodia's capital city, most rural areas still suffer from a decrepit and war-torn water supply system. There is no water fluoridation in Phnom Penh and there is no safe water supply to the people in rural areas. Water fluoridation, in particular for Phnom Penh, is needed and would have a beneficial effect on the oral health of all its citizens²⁸. Despite its low cost and high effectiveness in dental caries prevention, no action has been taken due to lack of resources and technical support²⁹. Other fluoride agents such as fluoride tablets, and fluoridated salt should also be considered for helping prevent caries in children in rural areas.

No twelve-year-old child in this survey was found with healthy gums and more than half of the children had calculus on their teeth. Almost all of the six sextants had associated bleeding gums with or without calculus. Almost one third of the children had never brushed and about one tenth of the children did not brush regularly. Oral health education to teach them regular and proper brushing could greatly improve their oral health. In a country in which many people have a poor attitude towards oral health¹⁹ and which has a dentist-centered and curatively based dental care system³⁰, it is essential that dental nurses should be equipped with good knowledge and training in oral health promotion and education, so that they focus on prevention and practice effective primary oral health care programs.

Daily tooth brushing with fluoride toothpaste is an important oral hygiene habit for prevention of oral diseases. In this survey, many of the children who brushed used fluoride toothpaste. However, the caries experience of those who brushed with fluoride toothpaste was similar to those not using fluoride toothpaste. A search of the toothpastes available in the local markets showed there were at least eighteen brands of toothpaste costing from fifty cents to a US dollar. All of them were imported products and 14 claimed to contain fluoride; the remaining four were three from South Korea and an herbal toothpaste from China. The non-fluoride containing toothpastes were not cheaper than the fluoride ones. Local toothpastes are available but there are problems with quality. According to a toothpaste analysis done in 2007, more than 50% of toothpastes claiming to contain fluoride had less than 1000ppm³¹. Several fluoride containing herbal toothpastes had fluoride from 500 to 700 ppm. These fluoride toothpastes do not contain an optimal level of fluoride for caries prevention. This study found that the caries experience of the children who brushed with fluoride toothpaste was similar to that of children not using fluoride toothpaste. The Ministry of Health is presently working on the issue of toothpaste quality. Even though toothbrushes and toothpaste are readily available in Cambodia, and by the Western standard are relatively inexpensive, many

poor families have more basic and pressing needs which require financing¹⁸.

As Cambodia rebuilds its health and education systems, preventive programmes are essential to address the problem of poor oral health among Cambodian children. Oral health promotion strategies including water and salt fluoridation, daily tooth brushing programs and fluoride mouthrinsing and oral health education should be considered.

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References

1. Country Economy, Royal Government of Cambodia, (Accessed on March 5, 2007), <http://www.cambodia.gov.kh/unisql1/egov/english/country.economy.html>.
2. 1998-2020 First Revision Populations for Cambodia, National Institute of Statistics of Cambodia, (Accessed on March 5, 2007), http://www.nis.gov.kh/projcam/Index_Proj.htm.
3. National income Rankings, World Bank, (Accessed on March 5, 2007), <http://www.gsdi9.cl/english/docs/NationIncomeRankings.pdf>.
4. Oral Health Care System, Oral Health Office, Ministry of Health, (Accessed on March 5, 2007), <http://www.oralhealthcambodia.com/menu%201/oral%20care%20system.htm>.
5. Durward CS, Todd R, So PK, Phlok S. A survey of the training, practice and dental health knowledge of traditional dentists practising in Phnom Penh, Cambodia. *Community Dent Health* 1994; **11**: 111-113.
6. Todd R, Durward CS. Utilisation of dental services in Cambodia and the role of traditional dentists. *Community Dent Health* 1994; **11**: 34-37.
7. Durward CS, Todd RV. The Cambodian National Oral Health Plan 1992-2000. *Int Dent J* 1993; **43**: 219-222.

8. Mallow PK, Klaipo M, Durward CS. Dental nurse training in Cambodia--a new approach. *Int Dent J* 1997; **47**: 148-156.
9. 1990-1991 Cambodian National Oral Health Survey, Durward CS, Todd R, So PK. WHO, Geneva.
10. 2003 Cambodia Country Report, Teng O, The 2nd Asian Conference of Oral Health Promotion for school children. Thailand,
11. World Health Organization, Oral Health Surveys. Basic Methods. (Forth Edition), Geneva 1997.
12. 2002 Cambodia Report, Church World Service, (Accessed on March 5, 2007), <http://www.churchworldservice.org/cambodia/2002annualreport/kompong.html>.
13. American Dental Association, American Dental Association Statement on the Death of Deamonte Driver, (Accessed on March 5, 2007), <http://imp4.webmail.hku.hk/horde/imp/message.php?index=10585>.
14. Otto M. For Want of a Dentist - Pr. George's Boy Dies After Bacteria From Tooth Spread to Brain. *The Washington Post*, February 28, 2007; Page B01.
15. Wong MCM, Lo ECM, Schwarz E, Zhang HG. Oral health status and oral health behaviours in Chinese children. *J Dent Res* 2001; **80**: 1459-1465.

16. Songpaisan Y, Davies GN. Dental caries experience in the Chiangmai/Lamphun provinces of Thailand. *Community Dent Oral Epidemiol* 1989; **17**: 131-135.
17. Petersen PE, Hoerup N, Poomiset N, Prommajan J Watanapa A. Oral health status and oral health behaviour of urban and rural schoolchildren in Southern Thailand. *Int Dent J* 2001; **51**: 95-102.
18. Todd RV, Durward CS, Chot C, So PK, Im P. The dental caries experience, oral hygiene and dietary practices of preschool children of factory workers in Phnom Penh, Cambodia. *Int J Paediatr Dent* 1994; **4**: 173-188.
19. Durward CS, Wright FA. Dental knowledge, attitudes, and behaviors of Indochinese and Australian-born adolescents. *Community Dent Oral Epidemiol* 1989; **17**: 14-18.
20. Leung WK, Chu CH. Dental caries and periodontal status of 12-year-old school children in rural Qinghai, China. *Int Dent J* 2003; **53**: 73-78.
21. Renson CE. Changing patterns of dental caries: a survey of 20 countries. *Ann Acad Med Singapore* 1986; **15**: 284-298.
22. 1983 Cultural background papers: Kampuchea, Laos and Vietnam, Department of Education and Youth Affairs. Canberra: Australian Government Publishing Service.
23. Randolph PM, Beck DJ, Durward CS. Dental health education in a refugee camp: an undergraduate student exercise. *Community Dent Health* 1987; **4**: 177-181.

24. Mallow PK, Durward CS, Klaipo M. Restoration of permanent teeth in young rural children in Cambodia using the atraumatic restorative treatment (ART) technique and Fuji II glass ionomer cement. *Int J Paediatr Dent* 1998; **8**: 35-40.
25. Llodra JC, Rodriguez A, Ferrer B, Menardia V, Ramos T, Morato M. Efficacy of silver diamine fluoride for caries reduction in primary teeth and first permanent molars of schoolchildren: 36-month clinical trial. *J Dent Res* 2005; **84**: 721-724.
26. Chu CH, Lo ECM, Lin HC. Effectiveness of silver diamine fluoride and sodium fluoride varnish in arresting dentin caries in Chinese pre-school children. *J Dent Res* 2002; **81**: 767-770.
27. Bendick C, Scheifele C, Reichart PA. Oral manifestations in 101 Cambodians with HIV and AIDS. *J Oral Pathol Med* 2002; **31**: 1-4.
28. Cambodian Dental Report, Workman G, (Accessed on March 5, 2007), <http://www.oralhealthcambodia.com/downloads/report%20garry%20workman.htm>.
29. 2001 Internal evaluation of the Oral Health Preventive School Program in Cambodia, Teng O Vuthy L, Vutha V, Chenda S, Sotheavy CK, Courtel F, (Accessed on March 5, 2007). <http://www.oralhealthcambodia.com/downloads/internal%20evaluation%20school%20prog%202001.pdf>
30. Durward CS, Todd RV. Rebuilding the ruins: dental services and manpower in Cambodia. *Int Dent J* 1991; **41**: 305-308.

31. Sithan H

Situation analysis of fluoride toothpaste in Cambodia, Personal Communication in the Meeting on the Future Directions for Fluoride Toothpaste in Cambodia, Ministry of Health, Cambodia, 2007.

Table 1**Caries experience (dmft \pm SD) of the 6-year-old children in rural districts of Cambodia**

District	Pailin	Kampong Thom	Kratie	All
No.	23	59	38	120
Decayed teeth (dt)	7.8 \pm 4.9	7.5 \pm 5.8	8.0 \pm 4.0	7.7 \pm 5.1
Missing teeth (mt)	0.4 \pm 0.9	0.2 \pm 0.6	0.2 \pm 0.6	0.2 \pm 0.6
Filled teeth (ft)	0	0	0	0
Dmft	8.2 \pm 5.4	7.7 \pm 5.8	8.2 \pm 4.1	7.9 \pm 5.2
% dmft=0 (n)	0	17% (10) ⁺	3% (1)	9% (11)

⁺Statistically significant between the groups, $P=0.01$.

Table 2**Caries experience (DMFT \pm SD) of the 12-year-old children in rural districts of Cambodia**

District	Pailin	Kampong Thom	Kratie	All
No.	59	79	58	196
Decayed teeth (DT)	1.2 \pm 1.5	1.2 \pm 2.0	1.0 \pm 1.3	1.1 \pm 1.6
Missing teeth (MT)	0	0	0	0
Filled teeth (FT)	0	0	0	0
DMFT	1.2 \pm 1.5	1.2 \pm 2.0	1.0 \pm 1.3	1.1 \pm 1.6
% DMFT=0	44% (26)	57% (45)	53% (31)	52% (102)

Table 3 Caries experience (dmft \pm SD) of the 6-year-old children according to gender

Gender	Boys	Girls	Total
No.	76	53	120
Decayed teeth (dt)	8.5 \pm 4.7	6.7 \pm 5.4	7.7 \pm 5.1
Missing teeth (mt)	0.2 \pm 0.7	0.2 \pm 0.6	0.2 \pm 0.6
Filled teeth (ft)	0	0	0
Dmft	8.8 \pm 5.2	6.9 \pm 5.6	7.9 \pm 5.6
% dmft=0 (n)	5% (3)	15% (8)	9% (11)

Table 4 Caries experience (DMFT±SD) of the 12-year-old children according to gender

Gender	Boys	Girls	Total
No.	78	118	196
Decayed teeth (DT)	1.0 ± 1.8	1.2 ± 1.5	1.1 ± 1.6
Missing teeth (MT)	0	0	0
Filled teeth (FT)	0	0	0
DMFT	1.0 ± 1.8	1.2 ± 1.5	1.1 ± 1.6
% DMFT=0 (n)	62% (48)	46% (54) ⁺	52%(102)

⁺Statistically significant between the two groups, $P=0.04$.

Table 5 Periodontal health status of 12-year-old children in rural districts of Cambodia

	Boys (n = 52)	Girls (n = 85)	Total (n = 137)
% Highest CPI = 0	0	0	0
% Highest CPI = 1	25% (13)	46% (39)	38% (52)
% Highest CPI = 2	75% (39)	54% (46)	62% (85)
Mean (\pm SD) number of sextants:			
Healthy (CPI = 0)	0.2 (0.6)	0.3 (0.7)	0.2 (0.7)
Bleeding only (CPI = 1)	3.1 (2.2)	3.6 (2.2)	3.5 (2.2)
With calculus (CPI = 2)	2.7 (2.4)	2.1 (2.3)	2.3 (2.3)

Table 6 Tooth brushing habit, use of fluoride toothpaste and snacks consumption of the 6- and 12-year-old children in rural districts of Cambodia

	6-year-old			12-year-old		
	Boys	Girls	Total	Boys	Girls	Total
Frequency of tooth brushing						
Never brush	33(49%)	20(38%)	53(44%)	22(28%)	22(19%)	44(22%)
Less than once daily	5 (8%)	3 (6%)	8 (7%)	18(23%)	11 (9%)	29(15%)
Once or more daily	29(43%)	30(56%)	59(49%)	38(49%)	85(72%)	123(63%)
All	67(100%)	53(100%)	120(100%)	78(100%)	118(100%)	196(100%)
Use of fluoride toothpaste						
Yes	26(39%)	24(45%)	50(42%)	44(57%)	69(59%)	113(58%)
No - No brushing	33(49%)	20(38%)	53(44%)	22(28%)	22(19%)	44(22%)
- non-F toothpaste	8(12%)	9(17%)	17(14%)	12(15%)	27(22%)	39(20%)
All	67(100%)	53(100%)	120(100%)	78(100%)	118(100%)	196(100%)
Snacks						
Yes	7(10%)	6(11%)	13(11%)	10(13%)	4 (3%)	14 (7%)
No	60(90%)	47(89%)	107(89%)	68(87%)	114(97%)	182(93%)
All	67(100%)	53(100%)	120(100%)	78(100%)	118(100%)	196(100%)