

**DENTAL CARIES, ORAL HYGIENE SKILLS,
AND NUTRITIONAL SKILLS OF SISIAN
SCHOOLCHILDREN AGED 12**

Master of Public Health Thesis Report Utilizing Professional Publication Framework

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Abstract

Dental caries causes teeth loss, aesthetic problems, inflammation of the gums and periodontium and affects chewing. Many factors such as lack of oral hygiene and proper nutrition skills are responsible for dental caries development. In Sisian region, Armenia, the prevalence of dental caries among children was about 80 percent in 2003. This study assessed the association between dental caries, oral hygiene and nutritional skills, among Sisian schoolchildren aged 12.

The study utilized a cross-sectional survey design. The sample size was calculated considering the 80 percent prevalence of dental caries, and 80 percent response rate. Systematic random sampling was used to select the study population (n=126).

The statistical analysis was conducted using the SPSS 11.0 and STATA 7.0 statistical packages. Simple and multiple linear regression analyses were performed to find and assess the association between different covariates and DMFT score.

The survey revealed that the prevalence of dental caries among 12 years old children was 86 percent. The mean DMFT score was 2.84 ± 1.95 . Dietary habits appeared to not affect the DMFT score. The situation was different regarding oral hygiene skills. Most of the participants (79 percent) did not have proper oral hygiene skills. The regression analysis suggested that daily twice teeth brushing could be protective against dental caries (regression coefficient 0.7 P=0.043). It was revealed also, that rural residence is associated with DMFT score (regression coefficient=1.1, P=.007). Results indicate a need to improve oral health skills and preventive practices among the study population. Further research is needed in investigating the possible causes of association between the place of the residence and dental caries. In addition, this survey revealed that schools and dental clinics did not participate in oral health encouragement, thus this study recommends including schools and dental clinics in oral health promotion campaigns among children.

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1. Introduction

Dental caries are chronic diseases of multifactor etiology and pathogens (Meskin, Berry and Currier, 1994). Many factors, such as bacteria *Streptococcus Mutans* and *Lactobacillus*, cariogenic diet, poor oral hygiene and salivary flow rate can cause dental caries (Meskin, Berry & Kennedy, 1996, Harris & Christen 1987, Schortenboer, 1971). Dental caries are one of the public health concerns for several reasons. Teeth affected with dental caries are sources of infection, which can cause an inflammation of dental pulp, periodontium, and gums (Borovski, Ivanov, Maksimovski & Maksimovskaya, 1998; Tatintcyan, Arevshatyan, Minalyan, et al. 1997). If left untreated, this disease gradually leads to teeth loss, which causes chewing difficulties and aesthetic problems (Allen, 2003).

Dental caries affects a large proportion of the world population, regardless of age, gender, ethnicity and place of residence (Hicks, Garcia-Godoy & Flaits, 2004; Wallace & Last, 1992). More than 98 percent of people worldwide suffer from dental caries (Tatintcyan, et al. 1997). According to Wallace and Last (1992), about 93.8 percent of adults in the United States had teeth affected by dental caries. The situation was about the same in Former Soviet countries. For example, in Moscow the prevalence of dental caries was estimated to be 97.2 percent and in Saint-Petersburg 96.2 percent (Tatintcyan et al. 1997).

2. Literature Review and Background

Dental caries are preventable diseases (Burton, Smith & Nichols, 1980). Water fluoridation is an effective tool for prevention of dental caries on the national level. In 1996 the fluoride levels in Yerevan water were below those recommended by the World Health Organization (WHO) (Chilingaryan, 1999). Currently there is no available data on water fluoride levels in Armenia.

Preventive interventions on individual and community level are directed to the maintenance of optimal oral hygiene and proper nutrition. These goals are reached through education and through delivery of preventive dental health services, which include professional cleaning of teeth by dentists and application of fluoride containing varnishes or gels (Petersen, 2003).

The current literature highlights the opinion, that correct oral hygiene reduces the risk of dental caries development. Almost all preventive programs usually include oral hygiene instructions or educational part of oral hygiene (Borovski et al. 1998; Tatintcyan et al. 1997; Harris & Christen 1987; Ingersoll, 1982). Many studies provided evidence of strong association between dental caries development and poor oral hygiene (Dohnke-Hohrmann & Zimmer 2004; Ohara, Kawaguchi, Shinada & Sasaki, 2000).

A preventive program, which consisted of educational part and fluoride varnish applications, was implemented from 1996 to 2000 in Neukolln, Germany (Dohnke-Hohrmann & Zimmer 2004). After completing the program, the research team carried out a cross-sectional study to evaluate the effectiveness of the program. A review of 80,589 dental records revealed a decline of Decayed, Missing, and Filled Teeth indices (DMFT shows sum of Decayed, Missing, and Filled Teeth of an individual), among children with average dental caries risk. The researchers concluded that proper oral hygiene, in combination with fluoride varnish applications twice a year, is effective in preventing incipient dental caries (Dohnke-Hohrmann & Zimmer 2004).

Japanese researchers conducted a program based on school dental health activities in Hiraizumi, Japan (Ohara, et al. 2000). The focus of this program was dental health education. The evaluation of this program showed that the improvement of oral hygiene skills resulted in a decline in dental caries indices among schoolchildren (Ohara, et al. 2000).

There is some controversy in the literature regarding the role of sugar consumption in dental caries development. A research conducted in Thailand among 12 years old schoolchildren, revealed an association between sugar consumption and dental caries development (Petersen, Hoerup, Poomvisent, Prommajan & Watanapa, 2001).

Burt and Pai (2001) have conducted a systematic review of the literature regarding this issue. They had reviewed and assessed about 69 reports of different studies. According to this investigation, only in one study the investigators found a strong relationship between sugar consumption and dental caries development. Nineteen investigations showed a moderate relationship, while the remaining studies found the relationship to be weak or none (Burt & Pai, 2001).

In the former Soviet Union, since mid 1970s, pediatric dentists were carrying out “dispansersatia” of children. The process included clinical examination of children and some preventive interventions. One of the preventive tools was “hygiene hours” in schools, during which schoolchildren received instructions about proper oral hygiene. The results of the educational part were evaluated using the Oral Hygiene Index of Feodorov-Volodkina (Index of Feodorov-Volodkina shows the amount of plaque on the teeth surface. The grade 5 is the highest grade and it shows absence of oral hygiene. The grade 1 is the lowest grade and it shows perfect oral hygiene.). The index was 4.5 in 1977 and in 1988 it decreased to 2.0. The DMFT index in was 4.5 1976 and it decreased to 1.8 in 1988 (Chilingaryan, 1999). According to the WHO recommendations, the lowest level of DMFT score is from 0 to 1.1 (Borovski, et al 1998). DMFT index equal to 1.8 shows low intensity of dental caries. So the “dispansersatia” and the preventive tools, which were used, showed high effectiveness in prevention of dental caries (Chilingaryan, 1999). However, after the collapse of the former Soviet Union, “dispansersatia” ceased. This resulted in increase in prevalence of dental caries and DMFT indices in Armenia.

After introduction of decentralization and privatization in health care system in the early 1990s, the surveillance of dental caries prevalence became irregular and inconsistent. Most of the dental clinics and polyclinics in Armenia are private, and are not regulated by the Ministry of Health. So these facilities do not report any data about dental caries prevalence and DMFT indices of served population to the Ministry of Health or to the State Health Agency.

In 2003 the United Methodist Committee on Relief (UMCOR) implemented Dental Care program in some regions of Armenia, during which dentists examined the schoolchildren and provided them with a treatment if needed. The program revealed that the prevalence of dental caries among Armenian schoolchildren was 80 percent. Unfortunately, the results of this program are not available by regions. Only Sisian region data are available: the prevalence of dental caries among schoolchildren was 80 percent. However, no studies explored the possible causes of high prevalence of dental caries among schoolchildren or designed a dental caries preventive plan.

From March to April 2005 all Sisian schoolchildren aged 12 were examined by a licensed dentist working in Sisian Stomatological Polyclinic. This check-up was ordered by the Ministry of Health of the Republic of Armenia. However, the official report of the results of the check-up was not available by the start of this survey.

The aim of this investigation was to examine oral hygiene and nutritional skills of schoolchildren aged 12, and to explore the association between oral hygiene, nutritional skills and dental caries.

The research questions of this survey were:

- What are the oral hygiene skills of schoolchildren aged 12 in Sisian region?
- What are the nutritional skills of schoolchildren aged 12 in Sisian region?

- Is there an association between dental caries development and oral hygiene skills of Sisian schoolchildren aged 12?
- Is there an association between dental caries development and nutrition related skills of Sisian schoolchildren aged 12?

The null hypotheses were:

- There is no association between dental caries development and oral hygiene skills of Sisian schoolchildren aged 12.
- There is no association between dental caries development and nutrition related skills of Sisian schoolchildren aged 12.

3. Methods and materials

3.1 Study setting

As it was already mentioned, the prevalence of dental caries was 80 percent among 12 years old children living in Sisian region. Considering the availability of dental records of schoolchildren aged 12 and the high prevalence of dental caries, this survey was conducted in Sisian region.

Sisian is one of the 4 administrative regions of Syunik marz and is situated 217 kilometers south-north from Yerevan. There are 5 secondary schools in Sisian town and 20 secondary schools in villages of Sisian region (Balasanyan, 2004). There is no available data regarding the number of 12-years-old children living in region.

3.2 Study population

The target population was children aged 12 at the start of the survey. This target group was selected, because they have permanent teeth and according to the recommendations of the WHO, assessment of the health of the permanent teeth should be done at 12 years of age (Borovski, et al. 1998).

The study population was schoolchildren of 4 randomly chosen Sisian schools aged 12 at the start of the survey. Three of the schools were town schools and the fourth school was a village school. Random number generator selected schools from the complete lists of town and village schools. The schools where UMCOR implemented Dental Care program were excluded from those lists. Schools #1, #2, and #5 were selected from the list of 5 Sisian schools, and the school of Brnakot village was selected from the list of 20 village schools.

3.3 Study design

To address the research questions a cross sectional survey was conducted. For this kind of studies cohort or case-control study designs could be utilized also. However, it was impossible to carry out a cohort study due to lack of time, financing and resources. Case control study design was not chosen due to anticipated lack of enough controls (healthy participants). Taking into consideration the time and cost-effectiveness, priority was set to the cross-sectional study design.

3.4 Sample size and sampling strategy

The sample size was defined using $n = z^2 * pq / d^2$ formula, where $z = 1.96$ for CI 95 percent, p is the proportion of those who have the desired characteristic, $q = 1 - p$ is the proportion of those who do not have the desired characteristic, d is a maximum difference between the true population and the study population that the investigators were willing to accept (Aday, 1996). For this study the power was set at 80 percent level, $z = 1.96$ for CI 95 percent, $p = 0.8$ (the prevalence of 80 percent), $q = 1 - p = 0.2$, the desired difference was 10 percent, so $d = 0.1$. The response rate was predicted to be about 80 percent, as the survey was conducted during the school time, and the questionnaire was not very long. The sample size adjusted for 80 percent response rate was $n = 74.4 = 75$.

After the selection of the schools, the dental records of the 12-years-old schoolchildren of those schools were obtained from the records of the Sisian Stomatological Polyclinic, and the survey participants were selected using Systematic Random Sampling.

Inclusion criteria were: all schoolchildren of the selected schools aged 12, who have a dental record in the Sisian Stomatological Polyclinic.

Exclusion criteria were: all schoolchildren of the selected schools, who were not 12 years old or do not have a dental record in the Sisian Stomatological Polyclinic.

There were about 183 schoolchildren aged 12 in selected town schools and about 35 schoolchildren in the selected village school. Every second schoolchild from the town schools and all 35 schoolchildren from a village schools were included in the survey. Totally 126 schoolchildren were selected as the study population.

3.5 Survey instrument

For this study data regarding the dental caries was collected from the dental records of the schoolchildren. Data regarding oral hygiene and nutrition habits were collected through self-administered questionnaire, some items of which were adopted from the already used instruments and some were designed with the assistance of two dentists (Okeigbemena, 2004; Al-Ansari, Honkala, Honkala, 2002). Included questions were easy to understand and allowed to reveal oral hygiene and nutritional skills. Prior to data collection, the questionnaire was pre-tested in one Yerevan school. Ten schoolchildren, aged 12 participated in pre-test. The pre-test revealed only minor problems with the questionnaire, and two questions were slightly changed.

The questionnaire had three domains: on oral hygiene, nutritional skills, and check-up visits to dentists. The oral hygiene domain had four questions, reflecting the weekly/daily frequency of teeth brushing, time of teeth brushing and the type of used toothpaste. These questions were mostly measured by a nominal scale. The domain on nutritional skills

consisted of ten questions, measured by nominal and ordinal scales. The domain on the check-ups consisted of three questions, measured by nominal scale.

3.6 Data collection

Data collection was performed in schools, during class times from 21st to 25th of May, 2005. The questionnaires were short, taking about 5-10 minutes to complete. In each classroom the survey lasted about 20-30 minutes. Schoolchildren asked a lot of questions about the purpose of the survey and about sampling methods, despite the fact that these issues were clarified in the consent forms, and were presented both to the parents and children in written form. The student investigator provided detailed answers to all the questions from the participants.

3.7 Study variables

Dependent variable was DMFT index. It was measured by numerical scale (0, 1, 2, 3...28) (Borovski, et al. 1998).

Independent variables were oral hygiene skills and nutritional skills. They were measured by nominal scale (presence/absence of proper skills).

As the dependent variable was measured by the numerical scale multiple linear regression analysis was performed to check the significance level of the stated hypothesis (Pagano & Gauvreau, 1994). For thorough analysis some new variables were defined. The correct hygiene variable presents the following habit: teeth brushing every day, twice, after the breakfast and after the supper (Kolesov, Kasparova, Jilina, Dobronravov & Leus, 1991). It was created using the responses to questions 2, 3 and 4 (Appendices 5&6).

To have variables describing sweet consumption in general, 2 new variables were created. Variable “eating sweets more than 3 times daily” presents sweet consumption more than 3 times a day. It was created from the responses to the question 6 (Appendices 5&6).

Eating and drinking sweets daily habit is defined by the variable “Eating and drinking sweets” which represents daily habit of eating sweets more than 3 times with drinking either sweet tea or sweet milk (Appendices 5&6).

4. Ethical Considerations

The study protocol was reviewed and approved by the Institutional Review Board of the American University of Armenia (AUA). The proposed study did not touch any sensitive issues, participation was voluntary and the participants could stop their participation at any moment. In addition, all participants were fully informed about the purpose of the survey, anticipated duration of their participation and their possible benefits.

For the performance of the survey, written consent from all participants and their parents or guardians was obtained (Appendices 1&2). Consent was obtained from the selected school directors also (Appendices 3&4). All identifiers (name and surname) were discarded after the data collection was completed. So it was impossible to identify any participant by the questionnaire.

5. Analysis

The data was coded and entered into Statistical Package for the Social Sciences (SPSS 11.0 version). There were both open-ended and close ended questions in the questionnaire. The close-ended questions were coded mainly as nominal data, and the open-ended responses were entered verbatim. For the data cleaning, screened entry technique and double entry were performed. The data entry lasted about two weeks.

Statistical analysis was performed using SPSS 11.0 and STATA 7.0 statistical packages. Continuous data was summarized as means and standard deviations. The categorical data was summarized in frequencies, and analyzed using chi square test. Simple

and multiple linear regression analyses were used to identify the potential predictors of the outcome variable (DMFT score).

6. Results

Initially 126 children were selected to participate in this survey. Only 9 of them (or their parents) refused to participate. The response rate was 93 percent. The followings are the study results regarding sample characteristics and domains:

6.1 Sample characteristics

One hundred seventeen children aged 12 participated in this survey. About 43 percent of the respondents were males and 57 percent were females. Of them 23 percent were from the village and 77 percent were from Sisian. The percentage of males and females was not significantly different by the place of residence ($P=0.838$) (Table 1) (Figure 1).

6.2 Oral hygiene skills

About 76 percent of survey participants cleaned teeth daily, 22 percent twice a week and 2 percent 1 time a week. The frequency of tooth brushing was not significantly different between males and females ($P = 0.255$). The percentages of children regarding tooth brushing frequency were different for urban and rural children ($P<0.001$). From the urban children, 86 percent cleaned teeth daily, while only 44 percent of the rural children had the same characteristic. Fifty two percent of rural children cleaned teeth 2-3 times a week (Table 2).

Those who clean teeth twice a day composed 44 percent of the respondents. Fifty-five percent of the respondents' cleaned teeth one time a day and 2 percent answered that they cleaned teeth more than twice a day. There were no statistically significant differences in frequency of teeth brushing across gender ($P=0.765$) and residence ($P=0.220$) groups.

Only 26 percent of all children cleaned teeth at appropriate time (after breakfast and after supper). There were no statistically significant differences regarding gender ($P=0.344$) or the place of residence ($P=0.348$) and the time of teeth brushing (Table 3).

In general, only 21 percent of the respondents had the correct oral hygiene habit. The percentage of children who had correct hygiene skills did not vary by the place of the residence ($P=0.138$) and gender ($P=0.093$) (Table 4). Most of the children (79 percent) used either fluoridated or Calcium or different herbs containing toothpastes.

6.3 Nutritional skills

Sweet consumption

Those who ate sweets more than 3 times a day composed 63 percent of the survey population. There was no one prevailing type of consumed sweet in this population. The children mentioned cakes, candies, chocolate, ice-cream and other types of sweets as the usually consumed sweets. The percentage of urban children (77 percent) consuming sweets more than 3 times a day was significantly higher ($P=0.025$), than of the rural children (23 percent). Statistically significant difference was also observed by gender. It appeared that girls consumed more sweets (57 percent) than boys did (43 percent) ($P=0.029$).

About 57 percent of children ate something sweet during the breaks between the classes. Only 33 percent ate something sweet between the meals, and 62 percent ate either a sandwich (not sweet) or an apple. The remaining 5 percent did not eat anything between the usual meals.

Sweet tea consumption

Eighty-two percent of the all respondents drank tea daily. Those who added sugar to tea were 93 percent of the survey population. About 78 percent of children drank sweet tea daily, adding on average 3 spoons of sugar to tea. The mean amount of added sugar was

3.23±0.92 ranging from 1.5 to 6.0 spoons. Tea drinking habit was not significantly different by gender (P=0.343) and by the place of the residence (P=0.598).

Milk/Milky products consumption

Only 10 percent of the respondents' drank milk daily, and most of them usually added sugar to milk (Mean 2.62 SD 1.21). There were no statistically significant differences in percentages among urban and rural children regarding this habit (P=0.949).

A half of the children used unsweetened milk products (matsoun, curds, sour cream) daily, 33 percent ate unsweetened milk products several times a week, and the remaining part do not use unsweetened milk products. Twenty nine percent of the surveyed children eat sweetened milk products (sweetened matsoun, curds, sour cream, etc) daily, and the remaining part eats these products either some times a week (28 percent) or do not eat at all (43 percent). It was revealed, that the percentage of children, who consume not sweetened milk products daily was higher among rural (80 percent), compared to urban children (40 percent) (P < 0.001). On the subject of the consumption of sweetened milk products, rural children (54 percent) reported more use of sweetened milk products (P=0.006). No statistically significant association was observed between the gender and consumption of sweetened milk products.

6.4 Other results

Visits to dentists for a check-up

Only 30 percent of the survey population had visits to dentists for a check-up. From those who had check-up visits, 66 percent were males and 34 percent were females (P=0.001). The frequency of check-up visits to dentists did not differ greatly by the place of residence (P=0.357) (Table 5).

Teaching of oral hygiene

From the all respondents 80 percent answered that someone has taught them how to clean the teeth. Overall 86 percent of urban children and 63 percent of rural children were taught how to maintain oral hygiene ($P=0.01$). From those respondents who were taught how to maintain their oral hygiene, 88 percent answered that they learned how to clean their teeth at home, 8 percent learned how to clean teeth at dental clinic and the remaining part learned how to clean their teeth either at school or from other sources (pamphlets, summer camps) (Figure 2). There were no significant differences in teaching of hygiene across the gender groups ($P=0.697$).

Dental caries and DMFT score

This survey revealed that the prevalence of dental caries was 86 percent. The prevalence of dental caries was the same both for the rural and the urban children ($P=0.962$) (Table 6). The prevalence of dental caries was not significantly different across the gender groups ($P=0.888$) (Table 6).

The mean DMFT score was 2.8 ± 1.95 (medium intensity of dental caries) ranging from 0 to 8 (Table 7). From those participants with a DMFT score=0 (healthy teeth), 76 percent were urban children and 24 percent were the residents of the village. The mean DMFT scores of urban and rural children were 2.6 ± 1.77 (low intensity of dental caries) and 3.8 ± 2.22 (medium intensity of dental caries) respectively. About 19 percent of the participants had high or very high intensity of dental caries (DMFT=4.5).

6.5 Results of Regression Analysis

The following independent variables were checked with the simple linear regression model as possible covariates to DMFT score (Table 8). Only daily frequency of teeth brushing (twice versus one time) and place of residence (urban versus rural) were statistically significantly associated with the DMFT score. The mean difference in DMFT score between

those who brushed teeth one time and twice was -0.82 (P= 0.023 95 percent CI -1.53, -0.118). Accordingly, those who brush teeth twice a day had DMFT score less by 0.82 than those who brushed teeth once a day. The mean difference in DMFT scores between urban and rural children was 1.22 (P=0.004 95 percent CI 0.40, 2.04). So the rural children had DMFT score higher by 1.22, compared to their urban peers.

All other variables were not statistically significantly associated with dental caries intensity (DMFT score). Data was further analyzed using multiple linear regression analyses. As only 2 variables were statistically significant, both of them were entered into a model of multiple linear regression analysis (Shardell, 2005).

In multiple linear regression analysis with daily teeth brushing frequency and place of residence, the results remained statistically significant for both variables. Thus the both predictors were left in the final model (Table 9).

There were no statistically significant confounders in the association between any variable and the outcome. The analysis also showed that there was not any statistically significant interaction between the covariates. The model was also checked for the residuals.

According to the final model, tooth brushing twice a day, adjusted for residence, was associated with decrease in DMFT score by 0.716 (Table 9). Living in a village, adjusted for the teeth brushing habit, increases DMFT score by 1.127 (Table 9). On the subject of the research questions of this study, it was found that only oral hygiene habits have association with the DMFT score. Neither nutritional skills, nor check-up visits were associated with DMFT score in this study.

7. Discussion

This study was conducted in Sisian region, considering the high prevalence of dental caries and availability of results of dental examination of schoolchildren, performed in 2005.

It assessed the prevalence of dental caries, DMFT scores, as well as investigated the association between DMFT scores, oral hygiene and nutritional skills.

The prevalence of dental caries among Armenian children living in regions was 80 percent in 2003 (UMCOR 2003). This prevalence is very high comparing with other countries: for example in Denmark the prevalence of dental caries among 12-years-old children was 40 percent in 2003 (WHO 2003). In USA about 67 percent of 12-17 years-old children had teeth affected by dental caries in 2001 (WHO 2001). So it can be concluded that the prevalence of dental caries among Sisian children was high. However, no studies were conducted to elucidate the possible reasons of this level of morbidity with dental caries among children.

The mean DMFT score was 2.8 ± 1.95 (medium intensity of dental caries) ranging from 0 to 8 (Table 7). The assessment of DMFT scores was done according to the recommendations of the WHO. To check the inter-observer reliability, a sub-sample of the study participants was re-examined by another dentist. The inter-observer reliability was calculated as percent agreement and Kappa statistics, which were 97.5 percent and 89 percent respectively. The global DMFT score of 12 years-old children (mean DMFT score worldwide) is 1.61 (WHO 2004). Accordingly, children living in Sisian region have higher intensity of dental caries than many of their peers living worldwide.

The oral hygiene habit was examined through 3 questions on weekly and daily frequency of teeth brushing, and the time of teeth brushing during a day. Comparing to the findings of a similar study conducted in Thailand, Sisian children brush teeth more frequently on a weekly basis than did Thai children. However, more Thai children brushed their teeth twice daily and on appropriate time during a day (Petersen, et al. 2001). Considering the observed negative association between oral hygiene and dental caries in both studies, the fact that less Sisian children had appropriate oral hygiene skills could explain higher prevalence

of dental caries among 12-years-olds in Sisian. The observed difference in weekly teeth brushing frequency by the place of the residence (urban vs. rural) is hard to explain, considering the lack of oral hygiene classes in both places of residence.

On the subject of the proper oral hygiene skills, it can be concluded that only 21 percent of participants had correct oral hygiene skills, as these children brushed teeth daily, twice and in proper time. This fact that only a few children had proper oral hygiene skills, could explain the level of dental caries intensity in Sisian region, since according to the studies conducted in Germany and Japan; the children without proper oral hygiene skills had high DMFT scores (Dohnke-Hohrmann & Zimmer, 2004; Ohara, et al. 2000).

Perhaps the lack of oral hygiene related knowledge is the cause of poor oral hygiene skills among Sisian schoolchildren. However, as during this survey the knowledge on oral hygiene was not assessed, this is only a hypothesis, that needs an investigation.

The role of fluorides in dental caries prevention is indisputable (Ismail, et al. 2001). Unfortunately there was no available information regarding the fluoride levels in Sisian drinking water. But taking into consideration the low levels of fluoride in Yerevan drinking water, it could be assumed that the levels of fluoride in Sisian water were also below the recommended levels. Taking into account that a studies conducted in London show that the use of fluoridated toothpastes was even more than essential in areas with low fluoride levels in water, it was very important that the vast majority (79 percent) of the participants of this survey, used fluoridated toothpastes (Jackson, et al. 2005).

The dietary habits were assessed as sweets consumption, sweet tea or milk consumption, milky products consumption and type of snacks between the meals on a daily basis. Most of the respondents reported sweets eating more than 3 times daily. It was much higher than the sweet consumption of the 12-years-old Thai children (Petersen, et al 2001).

However, considering the fact that during this survey the certain amount of consumed sweets was not reported, it was very difficult do draw any conclusions.

The vast majority of children (94 percent) reported eating snacks between the regular meals. In accordance with a similar study conducted in Sweden, eating snacks was not associated with dental caries development (Bruno-Ambrosius, Swanholm & Twetman 2005).

Sisian schoolchildren were more likely (76 percent) to consume sugar with tea and milk daily, when comparing to findings of a similar study conducted in Thailand (Petersen, et al. 2001).

The effect of dietary habits on dental caries development should be investigated in cohort studies, as for dental caries development sometimes years are needed. Probably the cross-sectional design of this survey was the underlying cause for the fact that no statistically significant association was observed between any dietary habit and dental caries development.

One anticipated finding of this investigation was the fact, that most of the respondents (70 percent) did not visit a dentist just for a check-up. The possible cause for not making visits for a check-up may be the absence of knowledge on the necessity for the visits. This issue is needed to be investigated further to understand better the underlying causes of preventive dental services underutilization in this population. The lack of association between check-up visits and dental caries development can be explained by the fact that during this survey the number of visits and the timeframe for that number were not assessed. And the check-ups and the prevention are considered to be effective when there are at least 2 visits (every 6th month) during a year (Borovski, et al. 1998; Ingersoll, 1986).

Regarding the issue of teaching of proper oral hygiene, most of the participants answered that they have learned how to clean their teeth at home. But taking into account that only 21 percent of study population had correct oral hygiene skills, it can be concluded that: either the parents did not had proper knowledge and skills on oral hygiene, or they had

correctly taught their children, but the children still did not have optimal oral hygiene skills. At this point it is impossible to state any conclusion without a doubt, considering the total lack of any studies conducted in Sisian regarding oral health issues.

On the subject of the place where children were taught how to maintain oral hygiene, unexpected was the fact that in Sisian dental clinics and schools did not participate in promotion of dental health activities. And as was shown by other studies, dental health activities carried out in schools and dental clinics are very successful in preventing the dental caries (Jackson, et al. 2005; Ohara, et al. 2000).

The interesting finding of this study was the observed positive association between the rural residency and dental caries (regression coefficient=1.127, P=0.004). Considering the similarities of dietary habits and oral hygiene skills of urban and rural children, and absence of studies focused on the place of residence, this finding is hard to explain based only on the data of this survey.

8. Limitations

One of the limitations of this study was the use of the not validated questionnaire, which could have biased the results of this survey.

The other limitation of the study is the possibility that the participants had over-reported the oral hygiene or under-reported the sugar consumption habits, as those responses were socially desirable. The research team tried to minimize this bias by ensuring the anonymity and confidentiality of the provided information.

The other limitation was the small number of participants from the villages. This limitation was due to time and resource constraints. The survey started on May 17th and after May 24th summer holidays started, so there were only 7 days for data collection. It was possible to conduct the survey by contacting the children at home, but, this would bias the results of the whole survey, as the data would be collected by different ways (group surveys

or self administered questionnaires). Considering these facts, it was decided to conduct survey only in one village school, but include all schoolchildren meeting the inclusion criteria. On the other hand, this could cause a selection bias, because the participants from the town schools were selected randomly and all rural children meeting the inclusion criteria were included in the study.

Because all the participants of this survey were residents of Sisian region, the results of this study cannot be generalized to other regions. And it is also a limitation of this study.

9. Conclusions and Recommendations

This study was very important, as it was the first step in investigating the causes of high prevalence of dental caries among Sisian schoolchildren. The most important finding of this study is the fact that the vast majority of children did not have correct oral hygiene skills. In view of the fact that the daily teeth brushing frequency was positively associated with DMFT score, improvement in oral hygiene skills can result in decrease in dental caries severity in this population. Based on this it could be recommended:

- To initiate an oral health promotion program to raise the knowledge of children on optimal oral hygiene and healthy nutrition, and teach children correct oral hygiene skills.

As the survey revealed that the majority of the children learned how to maintain their oral hygiene at home, and the schools and the dental clinics did not participate in oral health education and encouragement among schoolchildren, it is recommended:

- To involve schools and dental clinics in oral health promotion campaigns. This could increase the number of check-up visits, and improve the oral health of children.
- To initiate a research on the level of knowledge and attitudes to dental care among the parents. If the parents are knowledgeable on this issue, they will correctly teach their children how to maintain good oral health.

Regarding the effect of the place of the residence on DMFT score it is recommended:

- To initiate a research on factors that render rural children more likely to develop dental caries than their urban counterparts, in the presence of similar dietary and oral hygiene habits.

Probably the explanation for the observed association was the possible difference in water quality, or the reason could be more multifaceted than that. And as there is not any study regarding this issue, the suggested investigation will fill in the existing research gap.

Overall, this study was the first step in investigation of oral health issues in Sisian region. It revealed that the vast majority (86 percent) of children at age 12 had teeth affected by dental caries, and the mean DMFT score indicates medium intensity of dental caries.

In addition, the children did not have proper skills to maintain oral hygiene and healthy nutrition, which can result in deteriorated oral health and quality of life of a whole generation in future. Thus, to improve oral hygiene and nutritional skills of children, the implementation of different programs in Sisian region is essential.

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Tables

Table 1 Number and percentage of males and females by the place of the residence (in percentages and frequencies)

	Males	Females	Total
	% (Frequency)	% (Frequency)	% (Frequency)
Urban	42(38)	58(52)	77(90)
Rural	44(12)	56(15)	23(27)
Total	43(50)	57(67)	100(117)
<i>Pearson chi2 =0.0419 P =0 .838</i>			

Table 2 Frequency of teeth brushing by gender and the place of the residence (in percentages and frequencies by column)

	Frequency of teeth brushing		
	Daily	2-3 times a week	1 time a week
	% (Frequency)	% (Frequency)	% (Frequency)
Gender			
Males	42(37)	42(11)	6(2)
Females	58(52)	58(15)	0(0)
<i>Pearson chi2 = 2.7310 P =0 .255</i>			
Place of the residence			
Urban	86(77)	46(12)	50(1)
Rural	14(12)	54(14)	50(1)
Total (by column)	76(89)	22(26)	2(2)
<i>Pearson chi2 = 19.2979 P <0.001</i>			

Table 3 Daily times of teeth brushing by gender and the place of the residence (in percentages, by column)

Daily time of teeth brushing	Place of the residence		Gender	
	Urban	Rural	Male	Female
After the breakfast	24	97	30	25
Before the breakfast	27	19	26	24
After the supper	4	15	6	7
Before the supper	0	0	0	0
After breakfast & after supper	27	22	16	33
Before breakfast & After supper	9	4	10	6
After breakfast & before supper	1	0	2	0
Before breakfast & before supper	8	4	10	4
	<i>Pearson chi2 = 6.7172</i>		<i>Pearson chi2= 6.7523</i>	
	<i>P = 0 .348</i>		<i>P = 0.344</i>	

Table 4 Correct hygiene habit by gender and place of the residence (in percentages and frequencies)

Correct hygiene habit		
	Yes	No
	% (Frequency)	% (Frequency)
Gender		
Males	14(7)	86(43)
Females	27(18)	73(49)
<i>Pearson chi2= 2.8208 P =0 .093</i>		
Place of the residence		
Urban	24(22)	76(68)
Rural	11(3)	89(24)
Total (by column)	21(25)	79(92)
<i>Pearson chi2= 2.1976 P =0 .138</i>		

Table 5 Check -up visits to dentists by gender and place of residence (in percentages and frequencies)

Check -up visits to dentists		
	Yes	No
	% (Frequency)	% (Frequency)
Gender		
Males	66(23)	33(27)
Females	34(12)	67(55)
<i>Pearson chi2= 10.7755 P = 0.001</i>		
Place of the residence		
Urban	71(23)	79(65)
Rural	29(10)	21(17)

Total (by column)	100(33)	100(82)
<i>Pearson chi2= 0.8493 P =0 .357</i>		

Table 6 Dental caries prevalence by gender and place of residence (in percentages and frequencies)

Dental caries		
	Healthy	Decayed
	%(Frequency)	%(Frequency)
Gender		
Males	14(7)	86(43)
Females	15(10)	85(57)
<i>Pearson chi2= 0.0197 Pr =0.888</i>		
Place of the residence		
Urban	14(13)	86(77)
Rural	15(4)	85(23)
Total (by column)	14(17)	86(100)
<i>Pearson chi2=0 .0023 Pr = 0.962</i>		

Table 7 DMFT scores by gender and place of residence (in percentages)

DMFT score	Place of the residence		Gender	
	Urban	Rural	Male	Female
0	14	15	14	15
1	19	4	28	6
2	14	4	8	15
3	22	15	16	24
4	16	30	14	22
5	10	11	8	12
6	2	11	4	5
7	2	7	6	2

8	0	4	2	0
<i>Pearson chi2¹=5.5726 P = 0.018</i>		<i>Pearson chi2*=2.365 P = 0.124</i>		

¹Chi square test was performed to compare DMFT =2 with DMFT>2

Table 8 Simple Linear Regression of DMFT with different predictors

Factors	Regression coefficient	Std error	Confidence Intervals	P value
Rural place of residence	1.222	0.414	0.402, 2.04	0.004*
Genderfemale	0.240	0.364	-0.482, 0.963	0.511
Daily teeth brushing	-0.448	0.421	-1.28, 0.387	0.290
Daily twice teeth brushing	-0.824	0.356	-1.53, -0.11	0.023*
Time of teeth brushing	-0.095	0.458	-0.915, 0.725	0.818
Correct hygiene	-0.353	0.439	-1.224, 0.518	0.424
Check -up visits to dentists	-0.013	0.395	-0.795,0.769	0.974
Daily teadrinking	0.695	0.458	-0.212, 1.603	0.132
Daily sweet tea	0.533	0.432	-0.323, 1.389	0.220
Spoons of added sugar	0.343	0.205	-0.062, 0.749	0.096
Eating sweets more than 3 times daily	0.552	0.371	-0.184, 1.289	0.140
Daily sweet milk	-1.028	0.672	-2.358, 0.303	0.129
Eating and drinking sweets	0.493	0.359	-0.218, 1.204	0.172
Unsweetened milk	-0.019	0.264	-0.544, 0.505	0.941

products				
Sweetened milk products	-0.050	0.221	-0.448, 0.388	0.821

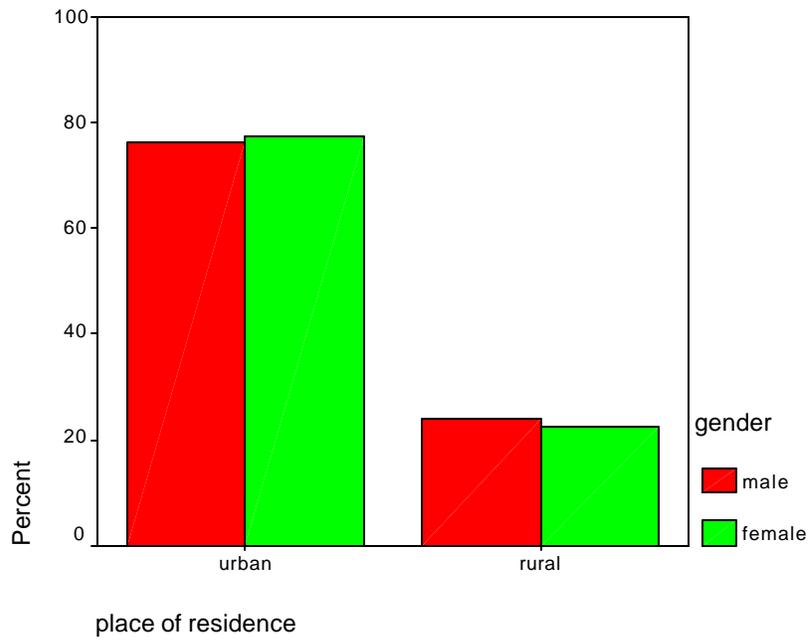
**Statistically significant result $P < 0.05$*

Table 9 Multiple Linear Regression Model

Factors	Regression coefficient	Std error	Confidence Intervals	P value	R squared
Daily frequency of teeth brushing	-0.716	0.349	-1.407, -0.025	0.043	0.104
Place of residence	1.127	0.411	0.313, 1.940	0.007	

Figures

Figure 1 Place of residence and gender



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Figure 2 Place where the children were taught how to maintain proper oral hygiene

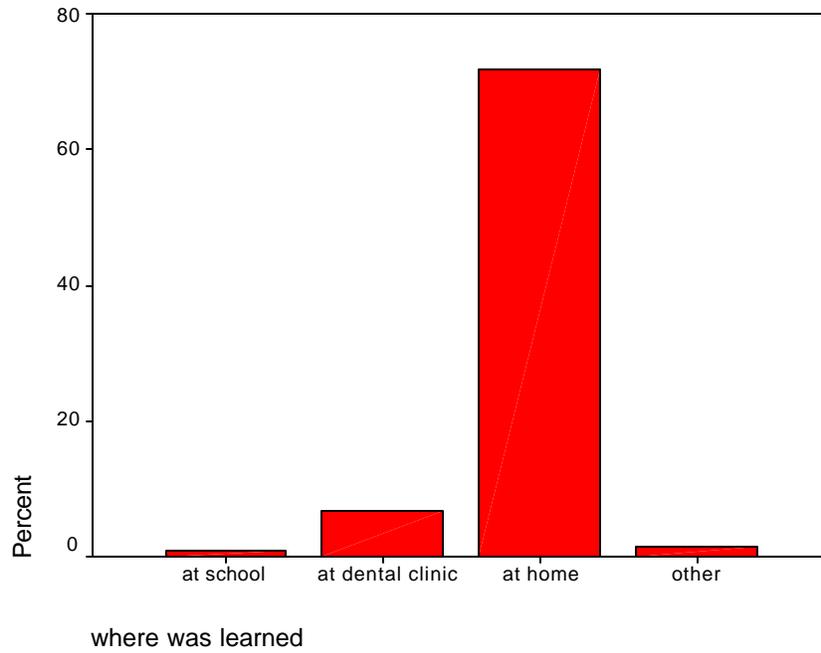
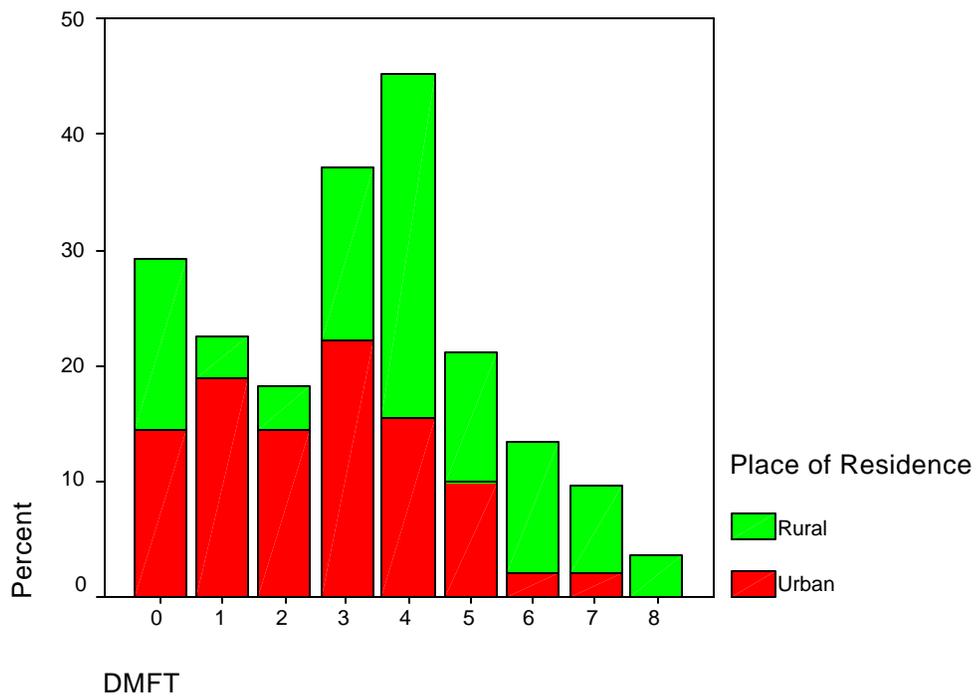


Figure 3 Place of residence and DMFT score



Appendix 2 Consent form in English for the participants

American University of Armenia College Of Health Sciences

Dental Caries, Oral Hygiene Skills and Nutritional Skills among Sisian schoolchildren aged 12 years old.

Dear participants!

This study is conducted by the second year student of AUA College of Health Sciences Anahit Tadevosyan and The American University of Armenia, to reveal the association between dental caries, oral hygiene skills and nutrition related skills. If the results of the survey show that the association exists, the research team will suggest strategies to prevent dental caries and to decrease the prevalence of dental caries among schoolchildren in Sisian region.

Schoolchildren aged 12 years were selected to participate to this study as it is known that the prevalence of dental caries among schoolchildren is high and because the schoolchildren of this age have permanent teeth. According to the recommendations of the World Health Organization, assessment of the health of the permanent teeth must be done at this age.

Computer randomly selected about 100 schoolchildren, aged 12 years old, to participate in this survey from the randomly selected 2 schools of Sisian region. You were selected to participate in this survey as you have met the selection criteria.

If you agree to participate to this survey, your child will be asked to fill in a questionnaire. It will take about 10-15 minutes to complete the questionnaire. Questionnaire contains questions about the participants nutritional and oral hygiene skills. The questionnaires will not be graded and will not be shared with anyone who is not member of the research team.

There is no direct benefit from the participation. However, if the survey reveals that the association exists, strategies for prevention of dental caries will be designed and their implementation can improve dental health of schoolchildren in Sisian.

This survey poses no risk for the participants. All information will be confidential. Every effort will be made to protect the confidentiality of the information provided insofar as it is legally possible.

It is your decision whether or not to be in this study. You can stop being in this study at any time. You should ask the person in charge listed below any questions you may have about this research study. *You* should ask him/her questions in the future if you do not understand something about the study.

If you want to talk to anyone about this research study you should call the person in charge of the study, Michael Thompson at (01) 512560 or e-mail mthompso@aua.am, or call Anahit Tadevosyan (0830) 42-40. The person in charge of the study will answer your questions.

If you want to talk to anyone about the research study because you feel you have not been treated fairly or think you have been hurt by joining the study you should contact the American University of Armenia at (374 1) 51 25 68.

THIS CONSENT FORM CONTINUES ON THE REVERSE SIDE

Side Two (Consent Form Template/ New Research Project)

If you agree to be in this study, please sign your name below (both the parent and the child).

Parent's signature

Child's signature

NOT VALID WITHOUT THE COMMITTEE
OF IRB STAMP OF CERTIFICATION

Signature of Investigator

Date

CHRNo.

Note: Signed copies of this cogent form must be a) retained on file by the Principal Investigator, b) given to the participant, and c) put in the patient's medical records (when applicable).

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Appendix 4 Consent form in English for the heads of schools

American University Of Armenia College Of Health Sciences

Dental Caries, Oral Hygiene Skills and Nutritional Skills among Sisian schoolchildren aged 12 years old.

Dear Director of the school!

This study is conducted by The American University of Armenia and the second year student of AUA College of Health Sciences Anahit Tadevosyan, to reveal association between dental caries, oral hygiene and nutrition related knowledge and skills. If the results of the survey show that the association exists, the research team will suggest strategies to prevent dental caries and to decrease prevalence of dental caries among schoolchildren in Sisian region. Computer randomly selected 4 schools and then 126 schoolchildren to participate in this survey.

Schoolchildren aged 12 years were selected to participate to this study as it is known that the prevalence of dental caries among schoolchildren is high and because the schoolchildren of this age have permanent teeth. According to the recommendations of the World Health Organization, assessment of the health of the permanent teeth must be done at this age.

If you agree to participate to this survey, the schoolchildren will be asked to fill in a questionnaire. It will take about 5-10 minutes to complete the questionnaire. Questionnaire contains questions about the participants nutritional and oral hygiene skills.

Children will be free to withdraw from the study at any time they want. There will be not any penalties or punishments for that. The questionnaires will not be graded and will not be shared with anyone who is not member of the research team.

There is no direct benefit from the participation. However, if the survey reveals that the association exists, strategies for prevention of dental caries will be designed and their implementation can improve dental health of schoolchildren in Sisian.

This survey poses no risk for the participants. All information will be confidential. Every effort will be made to protect the confidentiality of the information provided insofar as it is legally possible.

It is your decision whether or not to be in this study. You can stop being in this study at any time. Whether or not you are in the study will not affect your job. You should ask the person in charge listed below any questions you may have about this research study. *You* should ask him/her questions in the future if you do not understand something about the study. The researchers will tell you anything new they learn that they think will affect you.

If you want to talk to anyone about this research study you should call the person in charge of the study, Michael Thompson at 512560 or e-mail mthompso@aua.am, or call Anahit Tadevosyan (0830) 42-40. The person in charge of the study will answer your questions. If you want to talk to anyone about the research study because you feel you have not been treated fairly or think you have been hurt by joining the study you should contact the American University of Armenia at (374 1) 51 25 68.

THIS CONSENT FORM CONTINUES ON THE REVERSE SIDE

Side Two (Consent Form Template/ New Research Project)

If you agree to be in this study, please sign your name below.

Director's signature

NOT VALID WITHOUT THE COMMITTEE
OF IRB STAMP OF CERTIFICATION

Signature of Investigator

Date

CHRNo.

Note: Signed copies of this cogent form must be a) retained on file by the Principal Investigator, b) given to the participant, and c) put in the patient's medical records (when applicable).

5. *ÆÝā ³í ³ÙÇ Û³ Íáóĭ »ù éáí áñ³ μ³ ñ ú· ĭ ³. áñĭ áóÙ (ËÝ¹ñáóÙ »Ù· ñ»É ³Ýĭ ³ÝáóÙÁ) ?*

6. *ÚñÁ ù³ ÝÇ ³Ý. ³Ù »ù ù³ Óóñ»Õ»Ý áóĭ áóÙ ?*

7. *ÆÝā ù³ Óóñ»Õ»Ý »ù éáí áñ³ μ³ ñ áóĭ áóÙ?*

8. *ÆÝā »ù éáí áñ³ μ³ ñ áóĭ áóÙ ¹³ ë³ ÛÇçáóÝ»ñÇÝ?*

ÆÝā-áñ ù³ Óóñ»Õ»Ý (Βáĭ áÉ³ ¹, ĭ áÝÝ»ĭ , ËÙáñ»Õ»Ý ĭ³ ÛÇÝááñ ÝÙ³ Ý μ³ Ý)_____

àā ù³ Óóñ μáóĭ »ñμñá¹ (á³ Ýñáĭ , ĭ³ ñ³. áĭ , ĭ³ Û³ ÛÉ)_____

àāÇÝā_____

²ÙÉ _____ /ËÝ¹ñáóÙ »Ù á³ ñ½³ μ³ Ý»É/_____

9. *áóù ³Ù»Ý úñ Ā»Ĭ ËÙáóÙ »ù /ËÝ¹ñáóÙ »Ù ÝΒ»É ÛÇ³ ÛÝ Û»ĭ á³ĭ ³ëË³ Ý/?*

²Ùá_____

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àā ³Ù»Ý úñ, μ³ Ĭó μ³ ĭ³ ĭ³ ÝÇÝ Ñ³ ×³ Ë /ËÝ¹ñáóÙ »Ù · ñ»É Ā» Β³ μ³ ĀĀ ù³ ÝÇ

³Ý. ³Ù/_____

10. *áóù Ā»ĬÁ ù³ Óóñ »ù ËÙáóÙ ?*

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àā_____

11. *áóù ³Ù»Ý úñ ĭ³ Ā ËÙáóÙ »ù /ËÝ¹ñáóÙ »Ù ÝΒ»É ÛÇ³ ÛÝ Û»ĭ á³ĭ ³ëË³ Ý/?*

²Ùá_____

àā_____

àā ³Ù»Ý úñ, μ³ Ĭó μ³ ĭ³ ĭ³ ÝÇÝ Ñ³ ×³ Ë /ËÝ¹ñáóÙ »Ù · ñ»É Ā» Β³ μ³ ĀĀ ù³ ÝÇ

³Ý. ³Ù/_____

16. ä³ ñ½³ ä»ë ëi áó· Û³ Ý Ñ³ Û³ ñ³ i³ Û³ Ý³ μáóÙÁÇ³ Ûó»ÉáóÙ³ »ù?

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àã_____

17. Ò»½³ »ñμ³ ; éáí áñ»óñ»É³ »Ý ÇÝã»ë ; ä»i³ ù Û³ ùñ»É³ i³ Û³ Ý³ »ñÁ?

²Ùá_____

àã_____

»Ã» áã` μ³ ó ÑñÓ»ù Ñ³ ñó 18-Á

18. àñi³ »Ó³ »Ý Ò»½³ éáí áñ»óñ»É³ ÇÝã»ë ä»i³ ù ; Û³ ùñ»É³ i³ Û³ Ý³ »ñÁ?

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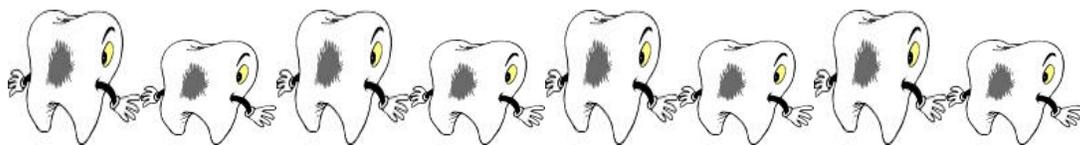
²ÙÉ³ _____ /ÉÝ¹ñáóÙ³ »ù ä³ ñ½³ μ³ Ý»É/_____

ÐÙáðÐ²Í² ÈàóÁÚáÆÙ Ð²ðó°ðÆÙ ä²i² ²é²É² Û°Èáó Ð²Ø²ð

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²i³ Û³ Ý³ μáóÁ³ i³ Ý³ ëi³ áó· Û³ Ý³ ñ¹ÙáóÝùÝ³ »ñÁ DMFt=

7	6	5	4	3	2	1	1	2	3	4	5	6	7
7	6	5	4	3	2	1	1	2	3	4	5	6	7



Appendix 6 Questionnaire in English

Please check on the appropriate box or write the requested answer in the space provided.

1. Your sex Boy_____ Girl_____

 2. How often do you brush your teeth?
 - _____ Daily
 - _____ 2-3 times a week
 - _____ once a week
 - _____ never

 3. How many times a day you brush your teeth?
 - _____ Once a day
 - _____ Other please specify _____
 - _____ Twice a day

 4. When do you usually brush your teeth? **(Read all then check one answer!)**
 - _____ In the morning, after the breakfast
 - _____ In the morning, before the breakfast
 - _____ In the evening after the last meal
 - _____ In the evening before the last meal
 - _____ In the morning before the breakfast and in the evening after the last meal
 - _____ In the morning, after the breakfast and in the evening after the last meal
 - _____ In the morning before the breakfast and in the evening before the last meal
 - _____ In the morning after the breakfast and in the evening before the last meal

 5. What toothpaste do you use usually? (Please, write the brand name of the toothpaste)
-

6. How many times a day you eat sweets usually?

7. What sweets do you eat usually?

8. Do you regularly drink tea?

_____ Yes

_____ No

If no skip to the question 10

9. Do you add sugar to your tea?

_____ Yes (approximately how many tea spoons?)_____

_____ No

10. Do you regularly drink milk?

_____ Yes

_____ No

_____ Not regularly but quite often (please write how often weekly) _____

If no skip to the question 12

11. Do you usually add sugar to milk?

_____ Yes (approximately how many teaspoons?)_____

_____ No

_____ Not regularly but quite often (please write how often weekly) _____

12. Do you regularly eat **unsweetened** milk products (sour crème, matsoun, curds, etc)?

_____ Yes

_____ No

_____ Not regularly but quite often (please write how often weekly) _____

13. Do you regularly eat **sweetened** milk products: (sweetened sour crème, sweetened matsoun, sweetened curds, etc with sugar or syrup)?

- _____ Yes
 _____ No
 _____ Not regularly but quite often (please write how often weekly) ____

14. What do you eat between meals?

- _____ Something sweet (a candy, a piece of cake, a biscuit, other sweets)
 _____ An apple
 _____ A not sweet sandwich (with cheese, butter or something else)
 _____ Nothing
 _____ Other please specify _____

15. Do you visit a dental clinic just for an examination?

- _____ Yes
 _____ No

16. Have you ever been taught how to clean your teeth?

- _____ Yes
 _____ No

17. Where you have been taught how to clean your teeth?

- At school _____
 At Dental Clinic _____
 At home _____
 _____ Other (please specify) _____

Thank You. Be always healthy

The results of dental examination DMFt=

7	6	5	4	3	2	1	1	2	3	4	5	6	7
7	6	5	4	3	2	1	1	2	3	4	5	6	7
