Risk Factors For High Caries Experience Among 16 Year Old School Children In Tumpat District, Kelantan

Principle Researcher:
Dr Nizam Abdullah

Co-researcher:
Dr Lin Naing@Mohd Ayub Sadiq

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UNIVERSITI SAINS MALAYSIA

LAPORAN AKHIR PROJEK PENYELIDIKAN JANGKA *PENDEK*

FINAL REPORT OF SHORT TERM RESEARCH PROJECT

Sila kemukakan laporan akhir ini melalui Jawatankuasa Penyelidikan di Pusat Pengajian dan Dekan/Pengarah/Ketua Jabatan kepada Pejabat Pelantar Penyelidikan

1. **Nama Ketua Penyelidik:**
Name of Research Leader

☑ Profesor Madya/ Dr Nizam Abdullah *Assoc. Prof.* ☐ Dr./ *Dr.* ☐ Encik/Puan/Cik *Mr/Mrs/Ms*

2. **Pusat Tanggungjawab (PTJ):**
School/Department

PPSG

3. **Nama Penyelidik Bersama:**
Name of Co-Researcher
Dr. Lin Naing@ Mohd Ayub Sadiq

4. **Tajuk Projek:**
Title of Project
Risk Factors for High caries Experience among 16 year old school children in Tumpat district Kelantan

5. **Ringkasan Penilaian/***Summary of Assessment*:	Tidak Mencukupi *Inadequate*		Boleh Diterima *Acceptable*	Sangat Baik *Very Good*	
	1	2	3	4	5
i) **Pencapaian objektif projek:** *Achievement of project objectives*	☐	☐	☐	☐	☑
ii) **Kualiti output:** *Quality of outputs*	☐	☐	☐	☐	☑
iii) **Kualiti impak:** *Quality of impacts*	☐	☐	☐	☑	☐
iv) **Pemindahan teknologi/potensi pengkomersialan:** *Technology transfer/commercialization potential*	☐	☐	☐	☐	☐
v) **Kualiti dan usahasama :** *Quality and intensity of collaboration*	☐	☐	☐	☑	☐
vi) **Penilaian kepentingan secara keseluruhan:** *Overall assessment of benefits*	☐	☐	☐	☐	☑

6. **Abstrak Penyelidikan**
(Perlu disediakan di antara 100 - 200 perkataan di dalam **Bahasa Malaysia dan juga Bahasa Inggeris.** Abstrak ini akan dimuatkan dalam Laporan Tahunan Bahagian Penyelidikan & Inovasi sebagai satu cara untuk menyampaikan dapatan projek tuan/puan kepada pihak Universiti & masyarakat luar).

Abstract of Research
(An abstract of between 100 and 200 words must be prepared in Bahasa Malaysia and in English).
This abstract will be included in the Annual Report of the Research and Innovation Section at a later date as a means of presenting the project findings of the researcher/s to the University and the community at large)

Please see attachment

7. **Sila sediakan laporan teknikal lengkap yang menerangkan keseluruhan projek ini.**
[Sila gunakan kertas berasingan]
Applicant are required to prepare a Comprehensive Technical Report explaning the project.
(This report must be appended separately)

Senaraikan kata kunci yang mencerminkan penyelidikan anda:
List the key words that reflects your research:

Bahasa Malaysia	*Bahasa Inggeris*
Karies gigi	Dental caries
~~Faktor berkaitan~~	~~Risk factors~~
~~Kadar Karies gigi yang tinggi~~	~~High Caries Risk~~

8. **Output dan Faedah Projek**
Output and Benefits of Project

(a) * **Penerbitan Jurnal**
Publication of Journals
(Sila nyatakan jenis, tajuk, pengarang/editor, tahun terbitan dan di mana telah diterbit/diserahkan)
(State type, title, author/editor, publication year and where it has been published/submitted)

Please See Attachment

(b) **Faedah-faedah lain seperti perkembangan produk, pengkomersialan produk/pendaftaran paten atau impak kepada dasar dan masyarakat.**
State other benefits such as product development, product commercialisation/patent registration or impact on source and society.

Tiada

* Sila berikan salinan/*Kindly provide copies*

(c) **Latihan Sumber Manusia**
Training in Human Resources

i) Pelajar Sarjana:
Graduates Students
(Perincikan nama, ijazah dan status)
(Provide names, degrees and status)

Dr Wan Salina Sulaiman

Sarjana Perubatan Masyarakat MCM (Oral Health)

Graduated 2006

ii) Lain-lain:
Others

9. **Peralatan yang Telah Dibeli:**
Equipment that has been purchased

Tiada

Tandatangan Penyelidik
Signature of Researcher

8/8/07.
Tarikh
Date

Komen Jawatankuasa Penyelidikan Pusat Pengajian/Pusat
Comments by the Research Committees of Schools/Centres

Diperakukan bahawa projek telah tamat dengan jayanya dan laporan adalah amat memuaskan.

TANDATANGAN PENGERUSI
JAWATANKUASA PENYELIDIKAN
PUSAT PENGAJIAN/PUSAT
Signature of Chairman
[Research Committee of School/Centre]

14/8/17
Tarikh
Date

DR. ADAM HUSEIN
PEMANGKU DEKAN
PUSAT PENGAJIAN SAINS PERGIGIAN
USM KAMPUS KESIHATAN
16150 KUBANG KERIAN, KELANTAN
MALAYSIA

8. Output dan faedah Projek

a) Penerbitan Journal

1) Submitted for Publication (Under review)
Wan salina, A. Nizam, L. Naing. The Association of Birth Order and socioeconomic factors with severity of caries experience among adolescents in tumpat. Archives of Oral Biology

b) Publication of Abstract

1) Wan Salina, A. Nizam. L.Naing. A Study on the prevalence of high caries among 16 yr old school children in Tumpat, Kelantan. 10th. National conference on medical sciences, USM 21-22 may 2005

2) Wan salina, A. Nizam, l. Naing. Oral health knowledge, attitude and practice among 16-yr old school children in tumpat. 4th Kelantan Public health Conference, USM 5-7 July 2005

3) Wan Salina, A. Nizam. Level of saliva mutans streptococci and lactobacilli in high caries group of 16 yr old school children in Tumpat. 4th. Kelantan public health conference, USM 5-7 July 2005.

Abstrak

Tujuan kajian ini dilakukan adalah untuk menentukan prevalens karies gigi, menentukan perbezaan pengetahuan, sikap dan amalan kesihatan mulut antara tiga kumpulan karies gigi yang berbeza dan menentukan faktor-faktor yang berkaitan dengan penyakit karies gigi dan karies gigi yang tinggi dikalangan pelajar sekolah berumur 16 tahun di daerah Tumpat, Kelantan.

Peringkat pertama kajian ini adalah kajian hirisan lintang untuk menentukan prevalens karies gigi. Peringkat kedua kajian ini adalah kajian kes-kawalan.

Hasil dari kajian ini menunjukkan prevalens karies gigi yang tinggi di Tumpat. Tahap pendidikan ibubapa, gigi susu yang tidak sihat dan ciri-ciri air liur adalah antara faktor penting yang berkaitan dengan karies gigi dan karies gigi yang tinggi. Sikap positif dan pengurangan pengambilan makanan bergula tinggi dapat mencegah karies gigi. Pengetahuan faktor-faktor yang berkaitan dengan karies gigi adalah sangat berguna dalam perancangan program pencegahan yang berkesan terutamanya dalam kumpulan karies gigi yang tinggi.

Abstract

The objectives of this study were to determine the prevalence of dental caries, the differences in knowledge, attitude and practice (KAP) level among caries experience group as well as to determine the associated factors for caries and high caries experience among 16-year-old school children in Tumpat district.

The first part was a cross-sectional study to determine the prevalence of caries and the second stage of this study was a case-control study.

The outcome of the study revealed that the prevalence of dental caries was high among the study group in Tumpat. Low educational level of parents, unhealthy deciduous teeth and salivary factors were important factors determining the caries experience. Positive dental attitude and low frequency of sugar intake had protective effect against caries experience. The knowledge on factors associated with caries experience is very useful in planning effective preventive dental program especially for group experiencing high caries.

Title:

Risk factors for high caries experience among 16 yr old school children in Tumpat district, Kelantan

Introduction:

Dental caries causes pain and suffering and it is a major problem among children and adolescents in many parts of the world. Successful incremental dental care system provided by the school dental services Ministry of Health Malaysia focusing on primary school children is made possible by the outreach program of the dental nurses since 1950s. Dental nurses play their role in both preventive and curative treatment of the school children and they are rendered 'no treatment required' before they leave primary school at 12 years of age. In secondary school, these groups of children are also seen by the dental nurses and dental doctors in the outreach program. However in Kelantan, we are facing a problem of shortage of manpower (1:28676 of dentist: population ratio), therefore leading to high caries prevalence in the secondary school children. Therefore it is important to identify the associated factors responsible for high caries experience for planning effective health promotion program for this group of population in the community.

Dental caries has multifactorial aetiology. Based on literature, most of the factors associated with caries among adolescents had been done in other countries, especially in the Western world. From the previous national oral health surveys and studies in our country, sociodemographic factors and behaviour that associated with dental caries among adolescents were studied. However, other associated factors including salivary factors and biological factors have not yet been studied in Malaysia.

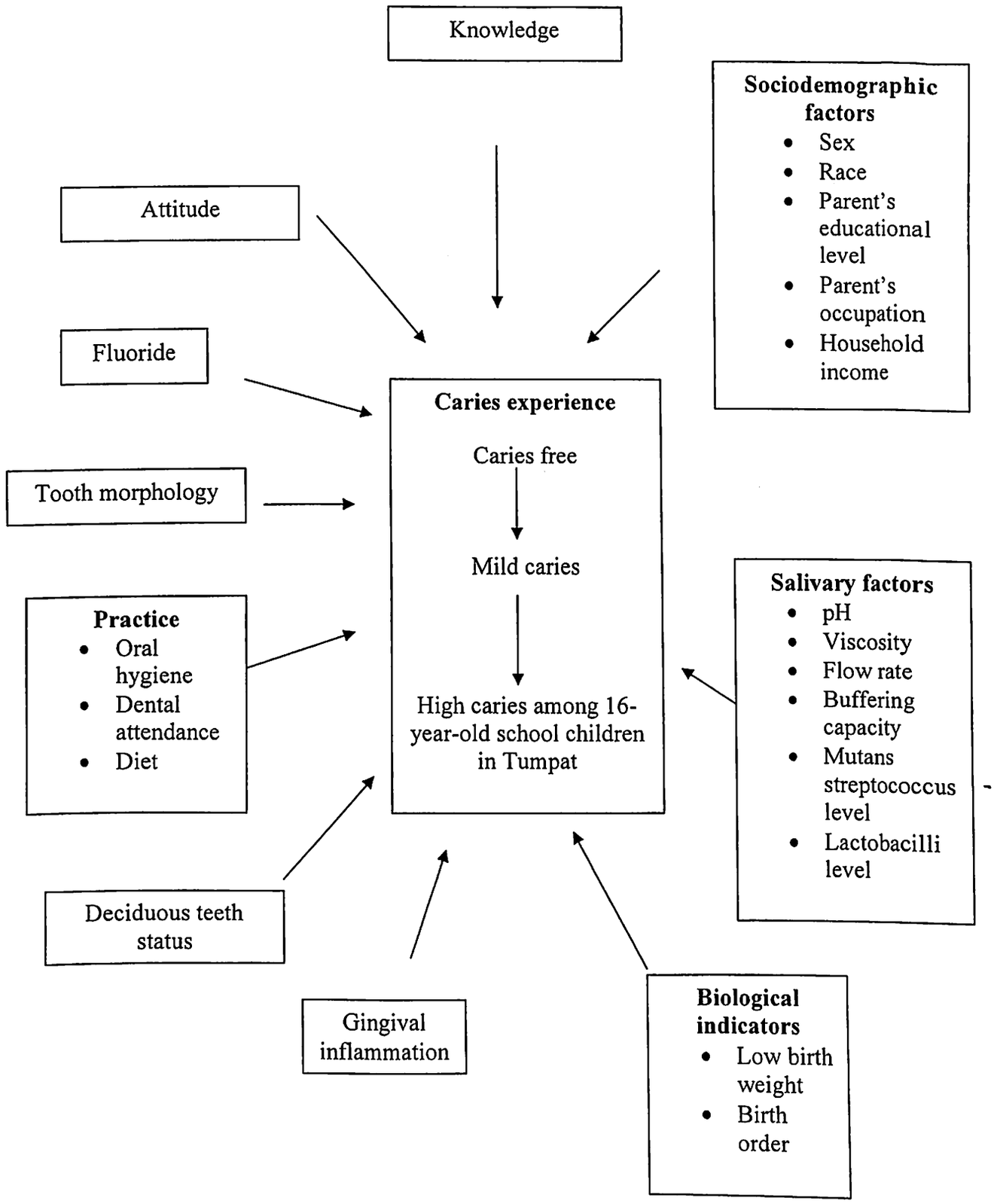


Figure 1.1 Conceptual framework of the study

Objectives of the study

General objective

To study on the factors that associated with caries experience among 16-year-old school children in Tumpat district, Kelantan

Specific objectives

1. To determine the prevalence of dental caries among 16-years-old school children in Tumpat district
2. To compare the knowledge, attitude and practice level between high caries, mild caries and caries free group
3. To determine the associated factors for dental caries among 16-year-old school children in Tumpat district
4. To determine the associated factors for high caries experience among 16-year-old school children in Tumpat district

Materials and methods

Study design

The design adopted was a cross-sectional study and followed by a case-control study. The first part of the study was a cross-sectional in nature to obtain the prevalence of dental caries.

Based on clinical examination in the first part of the study, subjects were grouped into high caries, mild caries and caries free group using the DMFS score. Cases were from the high caries and mild caries group while the caries free respondents formed the control. This study was conducted from July 2004 to February, 2005.

Population and sample

The reference population were all 16-year-old children from Tumpat district.

The source population were all 16-year-old school children from all the nine Sekolah Menengah Kebangsaan in Tumpat district. There were 2192 subjects altogether with 1168 of them were females and 1024 of them were males.

Sampling frame (eligible population) was determined based on the following inclusion and exclusion criteria.

Inclusion criteria:

1. Those whose birth date falls between 1st January, 1988 till 31 December, 1988.

Exclusion criteria:

1. Those with systemic diseases
2. Those on medication
3. Those wearing intraoral appliances

With these criteria 2115 subjects eligible to participate in this study.

Consent forms were distributed to all eligible school children. Out of 2115 subjects, 1119 of them were consented. Intraoral examination was then performed to evaluate the caries status using the DMFS index on 1087 subjects. Those not-consented and absent from school on the day of clinical examination were excluded.

Subjects were categorized into three groups based on their DMFS score. Those with DMFS score of ≥8 were categorized as high caries group (Freire *et al.*, 2001). There were 257 subjects in this group. Those with DMFS score of 1-7 were categorized as mild caries (635 subjects) while those with DMFS score=0 were the caries free group (195 subjects). In each group, 163 subjects were selected for the case-control study.

Subjects found having retained deciduous teeth during clinical examination were excluded before selection of subjects into the case-control study stage

Sample size

Sample size for prevalence of caries

The sample size was determined by using the following formula (Lwanga and Lemeshow, 1991) and parameters mentioned below. The precision was set at 0.05 and level of confidence was 95%, and therefore the Z value equals to 1.96. The P parameter (the expected proportion of individuals in the sample with the characteristic of interest) used was the prevalence of caries among 16-year-old school children in Kelantan from NOHSS'97 (Oral Health Division, 1998). The calculated sample size was 264 and the total sample size was decided as 290 subjects (10% non-response rate)

$$n = \left[\frac{Z}{\Delta} \right]^2 P(1-P)$$

n = the required sample size

P = prevalence of caries among 16-year-old school children in Kelantan (Oral Heath Division, 1998): 78.3%

Level of confidence = 95% (therefore Z = 1.96)

Δ = precision = 0.05

Therefore, required sample size (n) was 264 + 10% non-response rate

Total sample size was 290

Sample size for the two proportions comparison

For the Objective 3, only one variable (sex) was used for sample size determination because no other related factor was found for the P_0 parameter from the literature. Therefore, the sample size was determined based on this variable.

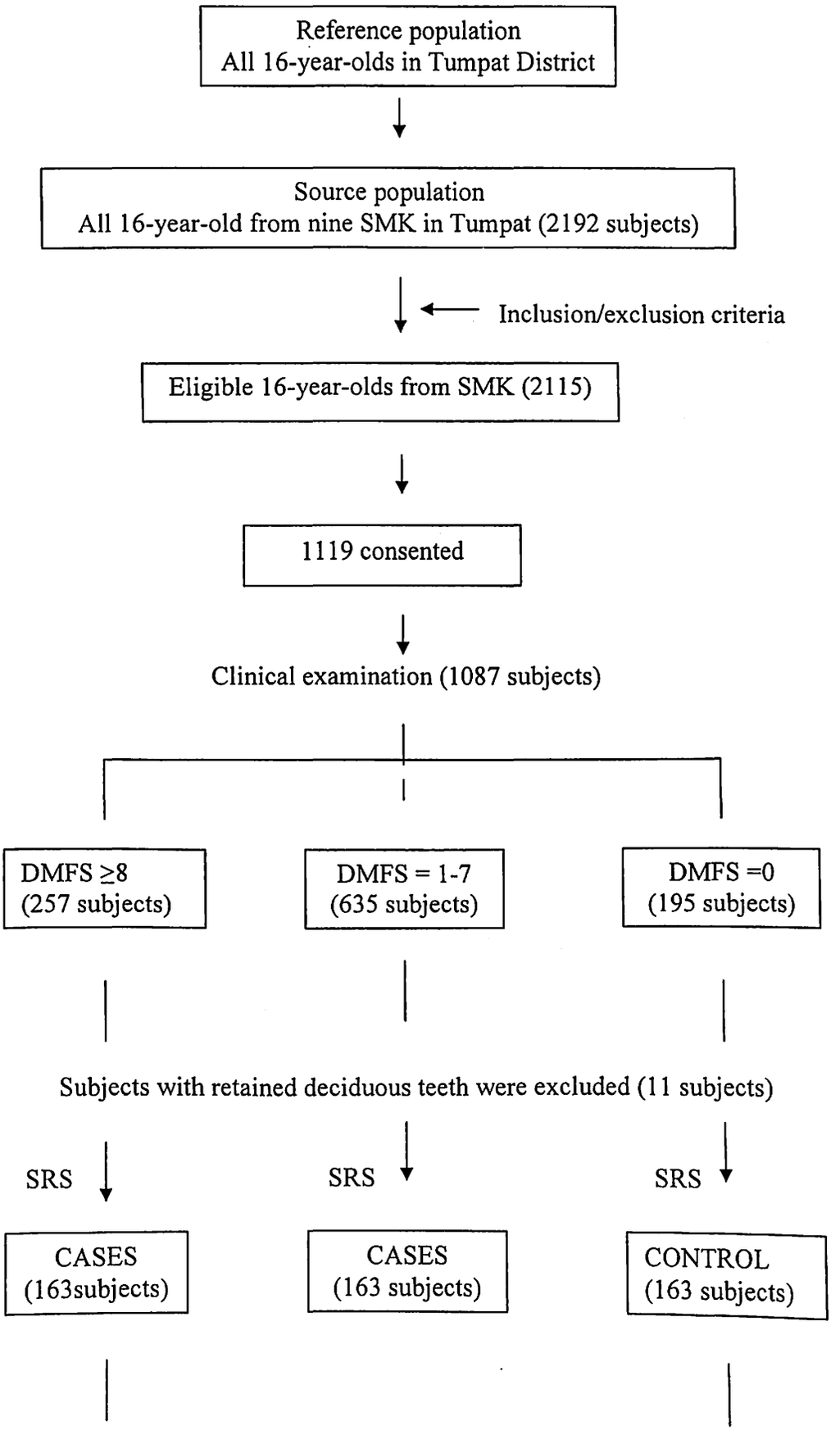
The sample size for Objective 3 (associated factors for caries) was based on two proportions comparison. It was determined using Power and Sample size calculation (PS) software (Dupont and Plummer, 1998) with requirement for significance level (α) of 0.05 and 80% power. The ratio of cases and control were 1:1:1 and detectable odds ratio was set at 2.0. Parameter P_0, the proportion of control group who are exposed, was estimated at 0.58, given by the proportion of girls in caries free group (Oral Health Services, 2003). The calculated sample size was 148 for each group and by considering of 10% non-response rate, making a total sample size 163. Therefore the total sample size needed for the study was 163 x 3=489 subjects.

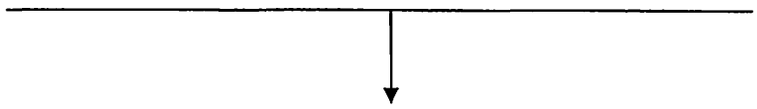
The sample size obtained from calculation for Objective 2 and objective 4 revealed lower sample size compared to Objective 3. Therefore the calculations were not shown.

Sampling method

In the first part of this study (prevalence study), the above calculated sample size was not used and no sampling was done. To get enough number of cases in the second stage of the study (case-control study), all subjects whose consented, not absent from school on the day of clinical examination and fit the inclusion and exclusion criteria were examined. Therefore enough sample size was obtained for the second stage of the study (case-control study).

Simple random sampling was applied to get 163 subjects for each group of caries free, mild caries and high caries and sub-sampled of 33 subjects for salivary microbiological tests in the case-control study.


Reference population
All 16-year-olds in Tumpat District
Source population
All 16-year-old from nine SMK in Tumpat (2192 subjects)
Inclusion/exclusion criteria
Eligible 16-year-olds from SMK (2115)
1119 consented
Clinical examination (1087 subjects)
DMFS ≥8
(257 subjects)
DMFS = 1-7
(635 subjects)
DMFS =0
(195 subjects)
Subjects with retained deciduous teeth were excluded (11 subjects)
SRS
SRS
SRS
CASES
(163subjects)
CASES
(163 subjects)
CONTROL
(163 subjects)



Administration of validated questionnaire

Saliva test[a]

Oral examination (Gingival Index)

SRS: Simple random sampling

[a] Saliva test was done for all subjects except for microbiological test where sub-sample of 33 subjects for each group using simple random sampling

Research Tools

Self-administered questionnaire

Questionnaire development

The self-administered structured questionnaire to assess knowledge, attitude and practice (KAP) regarding oral health in this study was developed in the Malay language. Although questions are easy to write, good questions are hard to write and require skills and experience (or expert advice), careful thought and practical testing (Abramson and Abramson, 1999). Therefore, to ensure good content validity of the questionnaire for this study, questions were discussed and improved with the presence of experts in Community Dentistry during questionnaire workshop after the selections of variables based on available literatures were made. In the workshop, dental public health specialists, master students of Community Medicine (oral health) and biostatistician were involved. It was organised on 15th April, 2004 to choose the domains and items to be included in each domain. The final questionnaires consist of five main sections:

A. Personal information

Date of birth, sex, race of subjects

B. Information from parents or guardians

Highest educational level was classified by the level of completion of parents' formal education (Oral Health Division, 1998). The higher educational level of either parents or highest educational level of guardian was chosen as the educational level of the parents.

Parents occupation (head of household occupation), monthly household income (the monthly income from the participating parent and spouse in the house were added together), birth order of subjects in the family, weight of the subjects at birth which was obtained from birth certificate and deciduous teeth status of the subjects were obtained.

C. Knowledge questionnaire

The questions asked were regarding causes, prevention and treatment of dental caries. Questions on knowledge were given 3 answer choices of "true", "false" and "don't know". Two points was given for each correct answer, one point for don't know answer and no point for wrong answer.

D. Attitude questionnaire

Questions were related to attitude towards intake of high sugar food, oral hygiene, seeking dental treatment and types of treatment. Responses were based on 5 point Likert scale; "Strongly agree", "Agree", "Not sure", "Disagree" and "Strongly disagree". One point was given for "Strongly disagree", "2 points for disagree", 3 points for "Not sure", 4 points for "Agree", 5 points for a "Strongly agree". Negative questions in which subjects were expected to strongly disagree with the statements were recorded giving the highest point on the "Strongly disagree" answer.

E. Practice questionnaire

Questions asked were related with oral hygiene practices, dental attendance practices and dietary practices.

Oral hygiene practice and dental attendance questions responses were: "Always", "Sometimes", and "Never" with the score of 2 points, 1 point and zero respectively for some oral hygiene practice questions. Subjects were asked to tick the suitable answers for other practice questions with score of 0-2 from poor practice to good practice.

Dietary practice: The Food Frequency Questionnaire (FFQ) which was used was a modification from the questionnaire of the "Kajian Pengambilan Makanan Malaysia 2002/2003 – Kekerapan Pengambilan Makanan dan Suplemen" (Ministry of Health Malaysia, 2002). Subjects were asked to fill up the FFQ form of listed food according to the frequency of intake in a day, a week, a month, a year and never. Scores given were 1 point for intake of once or more daily, 2 points for once or more weekly, 3 points for once or more monthly, 4 points for once or more yearly and 5 points for never.

The total score of knowledge, attitude, oral hygiene practice and dental attendance and dietary practices was computed by summing the scores of all related knowledge, attitude and practices statements. The outcome measures were the total score of knowledge, attitude, oral hygiene practice and dental attendance and dietary practice.

Validation of KAP Questionnaire

A pilot study was performed to validate and test the reliability of the questionnaire. This is to ensure that the questionnaire is suitable, adequate and appropriate to be used in the study population. The questionnaires were pre-tested among 40 subjects of the same age group from an Islamic-based school in Tumpat with the permission from Yayasan Islam Kelantan_which revealed poor validity and reliability. The questionnaires then piloted again among 40 subjects in a Sekolah Menengah Kebangsaan in Pasir Mas district after it has been improved before research was carried out.

Factor analysis was done to test the validity of the questionnaire. Factor analysis is often used to test the validity of ideas about items so that the researcher can decide how items should be grouped together into subscales and which items should be dropped (Dixon, 2000). The analysis was also used to determine items to be included and excluded but the result of factor analysis alone was not used in making this decision but in conjunction with theoretical aspects of the item. Hypothesized common factors were checked using Varimax (variance maximized) rotation method. Factor analysis was followed by computation of Cronbach's alpha coefficient, a measure of internal consistency reliability. After factor analysis and reliability analysis were done and taking into consideration of content validity, the questionnaire were then finalised and used in the main study.

The internal consistency reliability of each domain, number of selected items and the range of corrected item-total correlation of each item including the factor loadings in the second pilot study are shown in Table 4.1.

Table 4.1 Summary results of factor analysis and reliability analysis on 40 subjects

Domain	Items	Corrected item-total correlation	Cronbach-alpha	Factor loading[a]
Knowledge	9	0.18 - 0.29	0.48	0.13 - 0.59
Attitude	15	0.21 - 0.38	0.69	0.21 - 0.53
Oral hygiene practice and dental attendance	10	0.20 - 0.58	0.69	0.22 - 0.72
Dietary practice	15	0.21 - 0.52	0.76	0.29 - 0.64

[a] Principal Component Analysis for data extraction and Varimax rotation methods were applied

Due to the importance of some questions from the theoretical aspect, another 5 items in knowledge domain were included in the final version of questionnaire with the total items of 14. The total number of items selected altogether was 54 items. The possible maximum score were 28, 75, 20, 75 for knowledge, attitude, oral hygiene practice and dental attendance and dietary practice respectively. Based on reliability analysis, Cronbach-alpha value is rather weak for the knowledge domain (0.48) because internal consistency should exceed 0.7 (Bland & Altman, 1997) or 0.6 (Mc Kinley, 1997) to be regarded as satisfactory. However, due to time constraint, the questionnaires were used in the study.

Clinical examination

Caries status

Caries status was measured by DMFS score. Prior to the study, intra-examiner reliability was assessed by examining 40 16-year-old school children two times on two consecutive days to determine the accuracy and consistency of oral examination by the examiner. The kappa value was 0.95, which was considered almost perfect (Everitt, 1994). Specially designed clinical forms were used to collect the data.

Gingival index (GI)

Gingival tissues inflammation was assessed with the GI. Labial and palatal sites were assessed on all erupted teeth in the mouth which was a modification from Rugg-Gunn *et al.*, (1984).

Salivary testing kit

"GC Saliva Check Buffer Test" from GC Company

The "GC Saliva Check Buffer Test" from GC Company was used to check the resting flow rate, viscosity and pH of unstimulated saliva, flow rate and buffering capacity of stimulated saliva.

"Caries Risk Test (CRT) bacterial standard pack" and incubator

A testing kit from Vivadent was used to determine the level of mutans streptococci and lactobacilli in the saliva.

Data of GI and salivary analysis were recorded in a specially designed form.

Data collection

Prevalence study

Clinical examination was carried out at the school on a portable dental chair using portable dental light. The WHO criteria for registration of caries was used (World Health Organization, 1997). Disposable mouth mirrors was used to aid vision and disposable probes used to remove food or debris from the tooth surfaces. Intraoral examination was performed by the main researcher and assisted by one assistant. No air-drying of the teeth was done and radiographs were not taken. The prevalence of caries was obtained from all subjects as designated by DMFS score >0.

Case-control study

A. Self-administered questionnaire

The selected subjects were given the validated self-administered questionnaire to be filled in school. This session was supervised by the main researcher. A standard introduction that outlined the purpose of the study was provided. Care was taken to ensure that the

entire questionnaire was completed independently and without consultation from other individuals. Most subjects completed the questionnaire in approximately 20-25 minutes. Information about parents/guardians were filled in a different form at home by their parents and returned on the next day.

B. Salivary analysis

Saliva analysis was done in the morning at the school by using "GC Saliva Check Buffer Test" for hydration, pH, viscosity, stimulated saliva flow rate and buffering capacity and "CRT bacterial standard pack" from Vivadent. The methods used were according to instructions given by the manufacturer. The procedures were as follows:

1. Hydration (resting saliva flow rate)

The lower lip of the subject was everted. The labial mucosa was blotted with a small piece of gauze and observed under good light. Droplets of saliva will form at the orifice of the minor salivary glands. The time taken for the droplets of saliva to appear was recorded. If the time taken for this to occur was more than 60 seconds, the resting flow was considered to be below normal.

2. Viscosity

Resting saliva viscosity was assessed visually; either it is watery and clear, frothy and bubbly or sticky and frothy saliva. The watery, clear saliva was the normal viscosity of saliva and if it appears stringy, frothy or bubbly or very sticky, then it indicate the viscosity of saliva was increased.

4. pH

The pH strip was placed into the sample of resting saliva collected for 10 seconds and then color of the strip was compared with the testing chart. Healthy saliva has a range of pH 6.8-7.8 and pH value below that was considered as acidic.

5. Flow rate of stimulated saliva

Subjects were instructed to chew on a piece of wax (to stimulate salivary flow) and expectorate the saliva into the spittoon after 30 seconds. Chewing was continued for a further 5 minutes and saliva was collected into the collection cup at the regular intervals.

The total saliva collected (in ml) was recorded and was divided by time (5 minutes) to get the flow rate in ml/min.

5. Buffering capacity

A buffer test strip was removed from the foil sealed package and placed onto an absorbent tissue with the test side up. Using a pipette, sufficient saliva was drawn from the collection cup, and dispensed one drop onto each of test pads. The strip was then turned 90 degrees to soak up any excess on the absorbent tissue. The test pad then began to change color immediately and after 5 minutes the final result was available. The combined total of the test pad colour was then compared with the testing chart. The normal buffering ability of saliva ranged from 10-12. Values below that were grouped as low buffering ability of saliva (GC Company, 2002).

6. The mutans streptococci and lactobacilli level

In this study, a subsampling of subjects was done using simple random sampling due to high cost of the kit (33 out of 163 subjects). Following the manufacturers instruction, the stimulated saliva was used for this test

Procedure: The double-sided agar carrier was removed from the test vial, $NaHCO_3$ tablet was added and the agar surface coverings were removed. The tablet will react with saliva to produce CO_2, which enhances mutans streptococci growth. A pipette was used to apply saliva to completely cover both agar surfaces. Excess saliva was allowed to drip off, agar carrier was placed back into the vial and the vial lid was tightly closed (Vivadent, 2003). Incubation was done at 37° Celsius for 48 hours in the Craniofacial Laboratory, School of Dental Sciences. The numbers of adherent colonies were compared with the chart supplied by the manufacturer.

Before the salivary analysis, it is important to make sure that subjects refrain from eating, drinking, rinsing or cleaning teeth one hour prior to the test. Subjects were placed in a sitting position, not supine throughout the period of test.

C. Gingival inflammation

Examination of the gingival inflammation was done using the GI index modified from Rugg-Gunn (1984) using periodontal probe PCP 11, 150 mm. In this study, gingival inflammation was assessed on the labial and palatal site of all erupted teeth. The GI index was the mean score for the examined sites.

4.7 Statistical analysis

Statistical Package for Social Sciences (SPSS) for Windows Version 11.0 (SPSS Inc., 2001), Intercooled Stata, Version 7.0 (Stata Corp., 2001) and Stat/Transfer for Windows, Version 6.0 (Circle System Inc., 2001) statistical software package were used for data entry and analysis. Data was checked, explored and cleaned. Descriptive statistics such as means and standard deviation (SD) or median and Interquartile range (IQR) for continuous variables, and frequency and percentages for categorical variables were calculated for both stages of the study.

Data for KAP study was analysed based on the related scores. The data of differences in knowledge, attitude and oral hygiene practices and dental attendance and dietary practices was analysed using Analysis of variance (ANOVA) method to see the differences of the mean scores between the three caries groups. The level of significance was set at 0.05.

The association of the independent factor with the outcome was assessed using ordinal logistic regression. Ordinal logistic regression analysis assumes the outcome variable as having ordinality in categories (Hosmer and Lemeshow, 2000). Odds ratios obtaining from comparison of high caries versus caries free or mild caries and comparison of mild caries or high caries versus caries free are assumed to be equal. Therefore, it gives one odds ratio which is for each associated factor for caries and high caries experience. This ordinality assumption or proportional odds assumption is required to be tested by comparing with multinomial logistic model. Therefore, the associated factors for caries experience obtained from this study will the associated factors both for caries (comparing

with caries free group) and also associated factors for high caries experience (comparing with the other two groups – mild and caries free group).

Analysis was initially done using simple ordinal logistic regression and followed by multiple ordinal logistic regression.

In the multiple ordinal logistic regression method, stepwise variable selection method was used followed by likelihood ratio test (LR test) to ensure that only significant variables were included in the preliminary main effect model. Linearity of continuous variables to the logit of outcome was confirmed using the quartile-design method. Two way interactions and multicollinearity was also checked. Serious collinearity problem occur if Variance Inflation Factor (VIF) was more or equal to 10. The preliminary final model was tested for fitness using Hosmer-Lemershow goodness-of-fit test. If the test was not significant, the model was considered reasonably fit. Area under the ROC curve and classification table for sensitivity and specificity were also obtained in order to evaluate the model fitness. If area under the curve of ROC curve is ≥ 0.7, it is considered as acceptable discrimination (Hosmer and Lemeshow, 2000).

The assumption of proportional odds in the ordinal logistic regression model was checked by comparing final model of the ordinal and multinomial (polythomous) logistic regression model by using LR test. If the test is not significant, the proportional odds assumption is considered met and the application of ordinal logistic regression is appropriate.

In the analysis, a combination of categories was done when it was indicated. For the race variable, it was collapsed into Malay and non-Malay because of small percentages of other races among the subjects. The educational level of parents was grouped into upper secondary education (SPM or equivalent and higher) and lower secondary education (SRP or equivalent and below). Based on "Poverty Level Income" (PLI) in The Eighth Malaysia Plan, income was categorized into three groups that were poverty (less than RM500), above poverty and below average income (RM500-RM1300) and average

income (more than RM1300) during the analysis (Ministry of Women and Family Development, 2004). Birth order was categorized into first and second or later child in the family (Nicolau *et al.*, 2003), whilst birth weight was categorized into normal (≥2500 g) and LBW (<2500 g) (World Health Organization, 1984). Deciduous teeth status was grouped as healthy and unhealthy based on information given by parents. Saliva characteristics were grouped according to the manufacturer's guide. Salivary resting flow rate was categorized into normal (0-60 seconds) and low flow rate (> 60 seconds). Salivary pH was classified as normal (pH 6.8-7.8) and acidic pH (pH 5.0-6.6), whilst the buffer capacity was categorized as low if score 0-9 and normal if the total score ranged from 10-12 (GC Company, 2002). Both salivary mutans streptococci and lactobacilli level were categorized into $<10^5$ CFU/ml saliva and $\geq 10^5$ CFU/ml saliva based on the manufacturer's guide (Vivadent, 2003).

The ordinal logistic regression analysis was done to get the final model for the whole sample size (473) for all variables except for salivary microbiological tests. Both variables, salivary mutans streptococci and lactobacilli level with smaller sample size (98 subjects) were then added in the final model to see the significance.

Results

The sociodemographic profiles of the subjects in case-control study (n=473)

Sociodemographic profile	Case-control study (n=473)		
	Caries free (n=156) n (%)	Mild caries (n=157) n (%)	High caries (n=160) n (%)
Sex			
Male	65 (41.7)	42 (26.8)	43 (26.9)
Female	91 (58.3)	115 (73.2)	117 (73.1)
Race			
Malay	149 (95.5)	150 (95.5)	152 (95.0)
Chinese	0 (0.0)	0 (0.0)	2 (1.3)

Siamese	7 (4.5)	7 (4.5)	6 (3.7)
Indian	0 (0.0)	0 (0.0)	0 (0.0)
Parents education level			
University	7 (4.5)	7 (4.5)	3 (1.9)
College	7 (4.5)	2 (1.3)	0 (0.0)
Vocational institute	2 (1.3)	1 (0.6)	3 (1.9)
STPM or equivalent	5 (3.2)	10 (6.4)	7 (4.4)
SPM or equivalent	60 (38.4)	42 (26.7)	37 (23.1)
SRP or equivalent	24 (15.4)	32 (20.4)	34 (21.3)
Primary education	39 (25.0)	50 (31.8)	61 (38.1)
No formal education	12 (7.7)	13 (8.3)	15 (9.3)
Parents occupation			
Government	37 (23.7)	26 (16.6)	17 (10.6)
Private	9 (5.8)	19 (12.1)	9 (5.6)
Self-employment	106 (67.9)	103 (65.6)	128 (80.0)
Not working	4 (2.6)	9 (5.7)	6 (3.8)
Monthly household income (RM)[a]	500 (400)[a]	450 (350)[a]	420 (250)[a]

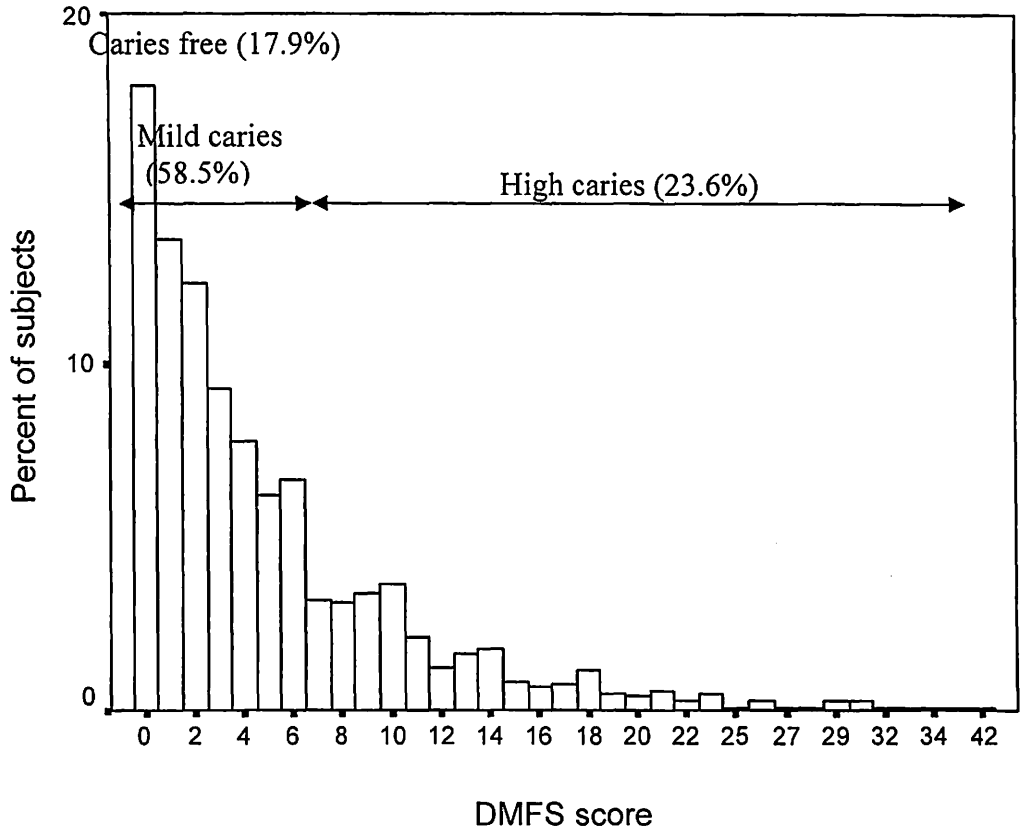


Table 5.3 Comparisons of mean knowledge scores among caries experience groups

Group	n	Mean (SD)	95 % CI mean	F (df)	*p* value [a]
Caries free	156	25.1 (2.98)	(24.6, 25.5)	1.71 (2, 470)	0.181
Mild caries	157	24.8 (2.46)	(24.4, 25.2)		
High caries	160	24.5 (2.93)	(24.0, 24.9)		

[a] One-way ANOVA

Table 5.4 Comparisons of mean attitude scores among caries experience groups

Group	n	Mean (SD)	95 % CI mean	F (df)	*p* value [a]
Caries free	156	60.8 (5.06)	(60.0, 61.6)	6.23 (2, 470)	0.002
Mild caries	157	59.9 (5,21)	(59.1, 60.7)		
High caries	160	58.7 (5.44)	(57.9, 59.6)		

[a] One-way ANOVA

Table 5.5 Comparisons of mean oral hygiene practice and dental attendance scores among caries experience groups

Group	n	Mean (SD)	95 % CI mean	F (df)	*p* value [a]
Caries free	156	12.1 (2.80)	(11.6, 12.5)	0.97 (2, 470)	0.378
Mild caries	157	11.8 (2.97)	(11.3, 12.2)		
High caries	160	11.6 (2.95)	(11.2, 12.1)		

[a] One-way ANOVA

Table 5.6 Comparisons of mean dietary practice scores among caries experience groups

Group	n	Mean (SD)	95 % CI mean	F (df)	*p* value [a]
Caries free	156	38.8 (7.44)	(37.7, 40.0)	1.23 (2, 470)	0.293
Mild caries	157	37.5 (7.95)	(36.2, 38.7)		
High caries	160	37.9 (8.23)	(36.6, 39.2)		

[a] One-way ANOVA

Results of the knowledge, attitude, oral hygiene practice and dental attendance and dietary practice comparing the three caries experience groups are shown in Table 5.3, Table 5.4, Table 5.5 and Table 5.6 respectively.

Results showed that only mean score of attitude was significantly different among the three caries experience group (p=0.002). Post-hoc test (Tukey HSD) confirmed that the difference was between caries free and high caries group (p=0.001). There were no significant differences of mean score of knowledge, oral hygiene practice and dental attendance and dietary practice among the three caries experience groups.

5.5.1.1 Sociodemographic factors by using simple ordinal logistic regression

Table 5.7 Association between sociodemographic factors and caries experience by simple ordinal logistic regression (n=473)

Socio demograpic factors	Caries free (n=156) n (%)	Mild caries (n=157) n (%)	High caries (n=160) n (%)	Crude OR	95% CI	χ^2 (df)[a]	p value[a]
Sex							
Male	65 (41.7)	42 (26.8)	43 (26.9)	1.00			
Female	91 (58.3)	115 (73.2)	117 (73.1)	1.69	1.18, 2.43	8.08 (1)	0.005
Race							
Malay	149 (95.5)	150 (95.5)	152 (95.0)	1.00			
Others	7 (4.5)	7 (4.5)	8 (5.0)	1.09	0.49, 2.41	0.05 (1)	0.827
Parents education level							
Upper secondary	81 (51.9)	62 (39.5)	50 (31.3)				

Lower secondary	75 (48.1)	95 (60.5)	110 (68.7)	1.00			
				1.92	1.36, 2.69	14.08 (1)	<0.001
Parents occupation							
Government	37 (23.7)	26 (16.6)	17 (10.6)	1.00			
Private	9 (5.8)	19 (12.1)	9 (5.6)	1.77	0.88, 3.53	9.99 (3)	0.106
Self-employed	106 (67.9)	103 (65.6)	128 (80.0)	2.06	1.30, 3.24		0.002
Not working	4 (2.6)	9 (5.7)	6 (3.8)	2.19	0.90, 5.33		0.083
Monthly household income (RM)							
< 500	92 (59.0)	98 (62.4)	115 (71.9)				
500-1300	44 (28.2)	46 (29.3)	37 (23.1)	1.00			
> 1300	20 (12.8)	13 (8.3)	8 (5.0)				
				0.75	0.51, 1.09	8.47 (2)	0.129
				0.43	0.23, 0.79		0.007

[a] Likelihood Ratio test

5.5.1.2 Biological factors, deciduous dentition and gingival inflammation by using simple ordinal logistic regression

Table 5.8 Association between biological factors, deciduous dentition and gingival inflammation and caries experience by simple ordinal logistic regression (n=473)

Variable	Caries free (n=156) n (%)	Mild caries (n=157) n (%)	High caries (n=160) n (%)	Crude OR	95% CI	χ^2 (df)[a]	*p* value[a]
Birth order							
First	31 (19.9)	27 (17.2)	28 (17.5)				
Others	125 (80.1)	130 (82.8)	132 (82.5)	1.00			
				1.13	0.73, 1.74	0.30 (1)	0.586
Birth weight							
Normal	145 (92.9)	147 (93.6)	153 (95.6)	1.00			
LBW	11 (7.1)	10 (6.4)	7 (4.4)				
				0.70	0.35, 1.41	1.00 (1)	0.317
Deciduous dentition							
Healthy	128 (82.1)	98 (62.4)	62 (38.8)				
Unhealthy	28 (17.9)	59 (37.6)	98 (61.2)	1.00			
				4.25	2.95, 6.12	64.64 (1)	<0.001

Gingival inflammation							
Mild	122 (78.2)	106 (67.5)	57 (35.6)				
Moderate	34 (21.8)	51 (32.5)	103 (64.4)	1.00			
				4.20	2.92, 6.05	63.26 (1)	<0.001

[a] Likelihood ratio test

5.5.1.3 Salivary factors by using simple ordinal logistic regression

Table 5.9 Association between salivary factors and caries experience by simple ordinal logistic regression (n=473)

Saliva variable	Caries free (n=156) n (%)	Mild caries (n=157) n (%)	High caries (n=160) n (%)	Crude OR	95% CI	χ^2 (df)[b]	*p* value[b]
Resting flow rate							
Normal	144 (92.3)	144 (91.7)	126 (78.7)				
Low	12 (7.7)	13 (8.3)	34 (21.3)	1.00			
				2.79	1.63, 4.78	14.54 (1)	<0.001
Viscosity							
Normal	76 (48.7)	39 (24.8)	22 (13.7)	1.00			
Increased	80 (51.3)	118 (75.2)	138 (86.3)				
				3.87	2.62, 5.72	48.89 (1)	<0.001
pH							
Normal	130 (83.3)	112 (71.3)	82 (51.2)	1.00			
Acidic	26 (16.7)	45 (28.7)	78 (48.8)				
				3.22	2.21, 4.68	39.00 (1)	<0.001
Stimulated saliva (ml/min)	1.09 (0.52)[a]	1.05 (0.59)[a]	0.84 (0.53)[a]	0.54	0.40, 1.35	15.92 (1)	<0.001
Buffering capacity							
Normal	110 (70.5)	60 (38.2)	36 (22.5)				
Low	46 (29.5)	97 (61.8)	124 (77.5)	1.00			
				4.82	3.36, 6.94	77.51 (1)	<0.001
Mutans streptococci							

level[c]							
$< 10^5$ CFU/ml	26 (81.2)	17 (51.5)	3 (9.1)	1.00			
$\geq 10^5$ CFU/ml	6 (18.8)	16 (48.5)	30 (90.9)	13.21			
					5.30, 32.89	37.82 (1)	<0.001
Lactobacilli level[c]							
$< 10^5$ CFU/ml	29 (90.6)	22 (66.7)	10 (30.3)	1.00			
$\geq 10^5$ CFU/ml	3 (9.4)	11 (33.3)	23 (69.7)	8.89			
					3.70, 21.39	27.41 (1)	<0.001

[a] Mean (SD)
[b] Likelihood Ratio test
[c] n=98 (subsamples; n=32 for caries free group, n=33 for mild caries group and n=33 for high caries group)

5.5.1.4 Knowledge, Attitude and Practice using simple ordinal logistic regression

Table 5.10 Association between knowledge, attitude and practice and caries experience by simple ordinal logistic regression (n=473)

Variable	Caries free (n=156) Mean (SD)	Mild caries (n=157) Mean (SD)	High caries (n=160) Mean (SD)	Crude OR	95% CI	χ^2 (df)[a]	*p* value[a]
Knowledge	25.1 (2.98)	24.8 (2.46)	24.5 (2.93)	0.94	0.89, 0.99	3.64 (1)	0.058
Attitude							
Low	73 (46.8)[b]	88 (56.1)[b]	107 (66.9)[b]	1.00			
High	83 (53.2)[b]	69 (43.9)[b]	3 (33.1)[b]	0.54	0.38, 0.75	13.06 (1)	<0.001
Oral hygiene & dental attendance practice	12.1 (2.80)	11.8 (2.80)	11.6 (2.95)	0.96	0.91, 1.01	1.78 (1)	0.183
Dietary practice	38.8 (7.44)	37.5 (7.95)	37.9 (8.23)	0.99	0.97, 1.01	1.14 (1)	0.287

[a] Likelihood Ratio test
[b] Frequency (%)

11 Associated factors for caries experience by multiple ordinal logistic regression (n=473)

Variable	Crude OR[a]	Adjusted OR[b]	95% CI	χ^2 (df)	*p* value
Parents education level					
Upper secondary	1.00	1.00			
Lower secondary	1.92	1.55	1.06, 2.28	5.10 (1)	0.024
Deciduous dentition					
Healthy	1.00	1.00			
Unhealthy	4.27	2.84	1.92, 4.20	28.18 (1)	<0.001
Gingival inflammation					
Mild	1.00	1.00			
Moderate	4.28	3.49	2.36, 5.16	40.41 (1)	<0.001
Saliva viscosity					
Normal	1.00	1.00			
Increased	3.87	2.12	1.36, 3.29	11.29 (1)	0.001
Saliva pH					
Normal	1.00	1.00			
Acidic	3.22	1.55	1.07, 2.58	5.23 (1)	0.022
Saliva buffering capacity					
Normal	1.00	1.00			
Low	4.82	3.54	2.37, 5.29	38.98 (1)	<0.001
Attitude level					
Low	1.00	1.00			
High	0.54	0.62	0.43, 0.91	6.15 (1)	0.034
Dietary practice	0.99	0.97	0.95, 0.99	4.53 (1)	0.013

[a] using simple ordinal logistic regression

[b] using multiple ordinal logistic regression