IJPHCS
Open Access: e-Journal

International Journal of Public Health and Clinical Sciences
e-ISSN : 2289-7577. Vol. 3:No. 2
March/April 2016

ASSESSING AND MODELING THE FACTOR THAT AFFECTED DENTAL CARIES AMONG PRESCHOOL CHILDREN IN BACHOK, KELANTAN, MALAYSIA

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ABSTRACT

A prevalence study of dental caries was undertaken in 5-6 year-old preschool children from Bachok District, Kelantan. In this study, sample consists of 382 children were collected in order to find the factor that affected the dental caries among children. Dental caries was examined visually by two dentists from School of Dental Sciences, Universiti Sains Malaysia and also the related information of the observations was recorded through the provided research form. The results showed that the prevalence of dental caries amongst 5-6-year old, is about 63.1% (high caries category). The increasing prevalence of dental caries among preschool children in Bachok need special systematic dental health education programmes. From the descriptives study, it shows only 5.2% children (no caries category), 11.3% (low caries category) and 20.4 % (moderate caries category). In this study, three techniques were used in order to find the factor that associated with caries status. The first technique by Cluster Analysis (CA), second is by Multiple Correspondence Analysis (MCA) analysis and the third is a Multiple Logistics Regression (MLR) analysis toward specific variables which will be discussed later in the next section. This paper focused on finding on dental caries factors modeling status scenario in Bachok, Kelantan.

Key-words: Structural equation modeling, dental caries, response surface methodology, preschool children and cluster analysis.

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1.0 Introduction to Cluster Analysis, Multiple Correspondence Analysis (MCA) And Multiple Logistic Regression (MLR)

In many countries in Asia, children have limited access to dental care, although general health care service at the hospital or clinic, for example, may be generally available. This phenomenon cause increasing the prevalence of dental caries and oral disease, particularly in childhood age. According to Moses, Rangeeth, and Gurunathanal (2011) and American Academy of Pediatric Dentistry (2002-2015), dental caries causes teeth pain, anxiety, eating impairment, loss of tooth among the children this has an effect on children concentration in education and also a financial burden on the family. The study targeted children within range 5-6-year-old. Dental examination and data collection was carried out for all selected preschool children in Bachok district, Kelantan. All the selected parameter was summarized In Table 1. Our aim was to investigate the associated factor to caries status by using multiple correspondence analysis (also known as biplot analysis) with respect to the categorization of weight for age (WAZ). Data was analyzed using statistical package for social science (SPSS version 22). We applied MCA in order to discover the relationship between caries status and categories of weight of children graphically. MCA exposes the multidimensional structure inherent in the data based on pairwise frequency tables. The principle results of MCA are a graphical display called biplot and it is given by a two-dimensional map (in our case caries status and the children weight categories). From the graphical displays, the associated factor will be grouped closely, according to the characteristics of the categories. Then, we applied the logistics regression method for our datasets. The odds ratio with 95% confidence interval (CI) was computed using MLR to assess the significant factor of association between status of dental caries with the independent variables (significant was set at $p < 0.25$ based on clinically important)

1.1 Sample Size Determination

Sample size for multiple regression analysis were calculated by using G*power with effect size = 0.02, $\alpha = 0.05$, power of the study = 0.68 and number of predictor were 2. The minimum sample size requires is 372 respondents.

Table1: Description of data among preschool children in Bachok, Kelantan, Malaysia (n=382).

Num.	Variables	Explanation of user variables
1.	Caries	Number of caries
2.	Deft	Caries Status 1 = Yes 0= No
3	Sex	Sex of Respondent
4	Income	Family Income
5	NoFamily	No of family member
6	Sweet Food	Taking of sweet food 1 = Yes 0= No

International Journal of Public Health and Clinical Sciences
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7	CatWAZ	Categorical of weight-for-age 1 = Underweight 2 = Severe Underweight 3 = Normal 4 = Overweight 5 = Obese
7	Age	Age of Children
8	BMI	Body Mass Index
9	Weight	Weight of children
10	Height	Height of children
11	Pscore	Practice score on dental caries
12	Ascore	Attitude score on dental caries
13	Kscore	Knowledge score on dental caries

2. Materials and Methods

In this section, we used three statistical approaches to analysis the dataset. A first approach is by doing cluster analysis. In this analysis, we divided the data to two groups of children. First cluster referring to the caries status and the second is referring to the number of caries occurs amongst children. Second, approaching of the analysis is Biplot analysis. This technique allows us to investigate the relationship between two nominal variables graphically in a multidimensional space (Amir, Nor Azlida, &Norizan, 2011). It computes row and column scores and produces plots based on the scores. Categories that are similar to each other appear close to each other in the plot. The third analysis is a logistic regression analysis. In this method, logistics regression is used for prediction of the probability of occurrence of an event by fitting data to a logit function curve. To explore the underlying association between in caries and the selected explanatory variables, a set of logistic regression model is fitted in this section. The definition of dichotomous dependent variables as follows; Y = 0, No carries occurs in children and Y= 1, Yes, carries occurs in children. In a given study population, if we call the probability of being a case π, then the probability of being a control (not a case) is a 1- π. Therefore, the odds of being a case is $(\pi/(1-\pi))$. The equation for simple logistics regression, that is, with one explanatory variables, is: $Y_i = E\{Y_i\} + \varepsilon_i$. And, the equation for multiple logistic regressions, where we want to look at the independent effect of number explanatory variables on the variables on the outcome, is:

$$\log(\pi/(1-\pi)) = \alpha + \beta_1 \text{BMI} + \beta_2 \text{Income} + \\ + \beta_3 \text{Age} + \beta_4 \text{NoFamily} \\ + \beta_5 \text{NoFamily} \times \text{BMI}$$

Where $\beta_1,...,\beta_5$ are parameters which is estimate using the through the Maximum Likelihood Estimation Method (MLE).

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3. Results and Discussion

3.1 Clusters Analysis.

Table 2: Result From Cluster Analysis

Cluster I	Cluster II
High Caries Status (100.0%)	High Caries Status (52.0%)
Mean Number of Caries 11.34≈11	Mean No of Caries 3.73≈4
Weight of Children (WAZ) 14.84 kg	Weight of Children(WAZ) 16.10
BMI of Children 13.60	BMI of Children 14.20
Score of Attitude 3.11	Score of Attitude 3.31
Score of Practice 10.88	Score of Practice 10.77
Score of Knowledge 11.85	Score of Knowledge 11.95
Sex of Respondent Female (55.2%)	Sex of Respondent Female (55.3%)

Table 2 suggests that the clusters are well separated. They are two clusters. First cluster is high in term of the number of caries amongst children and the second cluster is low number in caries among children. Its shows that caries occur mostly in female compared to the male children. Others than that, variables such as weight, BMI, less score of practice, less score of knowledge, and female are the factors that contributing to the numbers of the caries among the children.

3.2 Biplot Analysis.

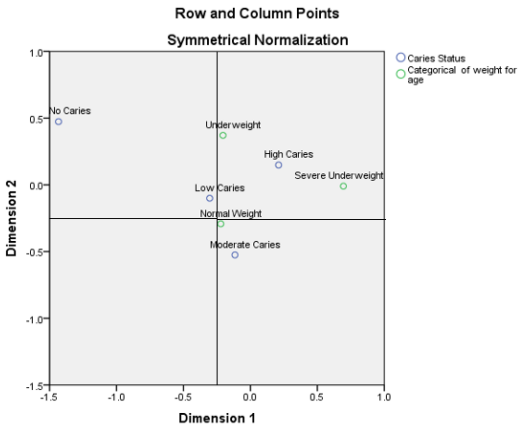

Figure 1: Caries Status with categorical of weight by age

International Journal of Public Health and Clinical Sciences
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Biplot techniques, allows us to investigate the relationship between two nominal variables graphically in a multidimensional space Amir et al. (2011). In our case (see Figure 1), high caries most occurs among children who are having underweight and severe underweight. A study that conducted by Anamariaet al. (2015) found that the underweight group presented a significantly higher DMFT (Decayed, Missing Filled Teeth) index compared to normal weight, overweight and obese. While, most of the low caries and moderate caries occur amongst children who are normal weight. According to Chopra, Rao, Gupta, Vashisth, and Lakhanpal(2015), the underweight, overweight, and obese children are at 2.7, 2.5, and 3 times the risk of developing caries as compared to children with normal BMI, respectively.

3.3Logistics Regression

Table 3: Dependent (DV) and independent variables (IDV)

Num.	Variables	Explanation of variables
Dependent Variables		
1.	Caries Status	Caries Status 1 = Yes 0= No
Independent Variables		
2.	BMI	Body Mass Index
3.	Income	Family Income
4.	Age	Age of Children
5.	No Family	No of family member

According to the results, the null hypothesis for the Hosmer Lemeshow goodness-of-fit test is the model is fit (Table 4). The value of p is 0.09 (it is not significant), therefore we do not reject the null hypothesis (the model is fit)

Table 4: Hosmer and Lemeshow Test

Chi-square	d.f.	Sig.
10.911	8	0.07

Figure 2 shows the plot of ROC Curve. The area under the curve is 0.754. The model can accurately discriminate 75.4% of the cases. It is significantly discriminate more than half of the cases.

Table 5: Area under the Curve

			Asymptotic 95% Confidence Interval	
Area	Std. Error[a]	Asymptotic Sig.[b]	Lower Bound	Upper Bound
.0754	.045	.000	.665	.843

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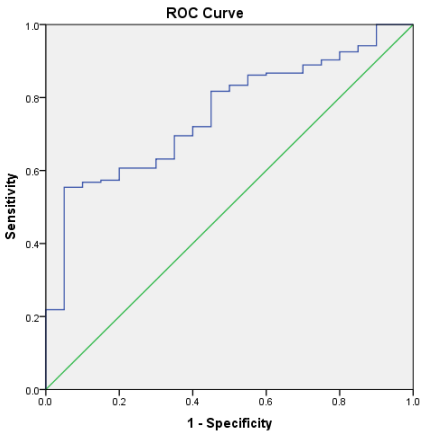

Figure 2: ROC Curve

The classification table shows 95.0% of the cases are predicted correctly whether they are with caries status or without caries status. It is good to validate the model that we obtained from SPSS, an Analog of Cook's influence statistics versus predicted probability can be used to validate the obtained model. In producing the Cook's distances plot, an analog of Cook's influence statistics was selected as the variable to plot on the *Y* axis, and predicted probability was chosen as the variable to plot on the *X* axis. The results are shown as follows

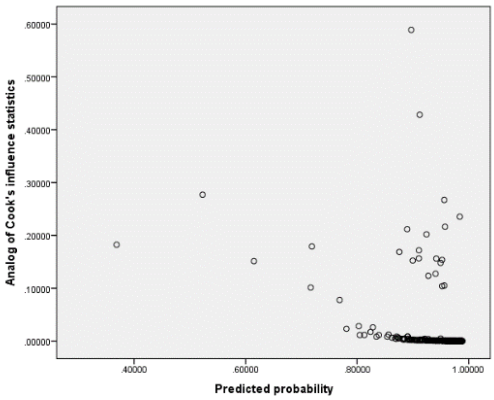

Figure 3: Analog of Cook's influence statistics versus predicted

The distribution of the Cook's distances plot shown as Fig.3. Generally, most of the dots locate in the right bottom of the plot, with some minor exceptions. Concretely, there are only about 24 dots of total 382 locate in high-leverage area. These minor exceptions can't be influential to the result in large amount. Data point with 1.0 is considered influential outlier. In our case, the data point's shows well confined dots and these indicate there is no outlier in our dataset. The Cook's distances plot shown as Figure 3 also indicates the effectiveness of the predictive model.

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Table 6: Classification Table[a]

Observed		Predicted		
		No of caries		Percentage Correct
		No	Yes	
No of caries	No	2	18	10.0
	Yes	0	361	100.0
		Overall Percentage		95.3%

Table 7: Variables in the Equation

	Beta	Wald Statistics	P Value	Exp(B)	95% C.I. for EXP(B) Lower	Upper
BMI	0.957	3.882	0.049	2.605	1.005	6.750
Age	-0.450	0.848	0.357	0.637	0.244	1.662
Num.Family	3.493	7.020	0.008	32.874	2.482	435.394
BMI by No Family	-0.221	5.764	0.016	0.802	0.669	0.960
Constant	-9.595	1.485	0.223	0.000		

*Variable(s) entered: BMI, Income, Age, No Family, BMI * No Family. Multiple logistics regression. The model reasonably fits well. Model assumption are met.*

Table 7 gives the logistic regression model that we obtained from the analysis. The main factor which associated were BMI, age and number of family members. It is clearly observed from the results that BMI (β = 0.957, 95% CL: 1.005, 6.750, *p*-value 0.049), Age (β =-0.450, 95% CL: 0.244, 1.662, *p*-value 0.357), number of family members (β = -3.493, 95% CL: 2.482, 435.394, *p*-value 0.008) and the interaction term between BMI by number of family members. (β = - 0.221, 95% CL: 0.669, 0.960, *p*-value 0.016). Results from a study that organized by Hilgers, Kinane, and Scheetz (2006) reported that children with increased BMI had a higher incidence of caries in permanent teeth (Sadeghi&Alizadeh 2007). In 2012, Malek, Hossienian, and Bakhteyar shows that there is a positive correlation between BMI and dental caries in 6 year old Iranian children. Shakya, Rao, and Shenoy (2013) focused on the correlation between malnutrition and dental caries in children. The finding showed that there a negative correlation between BMI and the number of dental carries in both types of dentition. According to the literature, children age factor plays an important role to the caries among the children. But in our study, was conducted in Kelantan (Bachok District), we found that the children age (β =-0.450, 95% CL: 0.244, 1.662, *p*-value 0.357) is not contributing to the caries among them. Similar results we obtained from Mustafa, Tuncer, and Yuceokur (2010). According to the Mustafa et al. (2010), gender and age do not affect the prevalence of caries on teeth sites. In addition, more caries are experienced in younger age groups, and their incidence decreases as age increases.

Our study found that, number of family members (β = -3.493, 95% CL: 2.482, 435.394, *p*-value 0.008) are the factor that contributing to the early childhood caries. Other studies also have found that the frequency of early childhood caries (ECC) is greater among children in families with a larger number of siblings (Corrêa-Faria, Martins-Júnior, Vieira-Andrade, Marques, & Ramos-Jorge, 2013). The interaction between two variables which is number of

family members and BMI variables shows a significant value due to number of caries with *p*-value 0.016.

4. Summary and Conclusion

The focused of this study is to find the factor that leads to the caries status by a different point of view. The first approaches are by cluster analysis. The present finding of this analysis is able to prove our knowledge on the influence of the factor that contributed to the caries factor among children in Bachok, Kelantan, Malaysia. There were five significant factors lead to high caries status, and female, less score of knowledge, less score of practice, lower BMI and lower of body weight. Second approaches by investigating the relationship between two nominal variables graphically in a multidimensional space. A significant finding can look through the Biplot analysis. The Biplot analysis suggests the highest caries most occurs among children who are having underweight and severe weight. This analysis provides comprehensive information and also the general idea of the prevalence caries status in Kelantanese children. The third approaches are by carrying out logistic regression analysis. Results from logistics regression shows that three factors that influence of the caries status, BMI, number of family members and the interaction between numbers of family members with BMI.

Acknowledgement

This research has been ethically clear by the Research and Ethics Committee (FWA Reg. 00007718; IRB Reg. No: 00004494) of School Dental Sciences (PPSG). The authors would like to acknowledge Universiti Sains Malaysia (USM) for providing facilities and not forgetting to Dean of School Dental Sciences, Deputy Dean (Affair & Network) and Deputy Dean (Research)of all the respondents of the questionnaires without their keen support, our work is not possible.

Declaration

Author(s) declare that,

1) The manuscript submitted is our original work, the manuscript has not been published and is not being submitted or considered for publication elsewhere.
2) There is no financial or other relationships that might lead to a conflict of interest among the authors in this manuscript.
3) All authors have seen and approved the manuscript as submitted.
4) Names of all authors are correctly.

Authors contribution

Author 1: Wan Muhamad Amir W Ahmad, Author 2: Ruhaya Hasan, Author 3: Nor Azlida Aleng, Author 4: Rosmaliza Ramli and Author 5: Nohafizah Ghani

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