ORIGINAL ARTICLE

The association of birth order and sociodemographic factors with caries experience among adolescents in Tumpat

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Abstract Sociodemographic factors have received considerable attention in the literature with regards its relationship with caries. However, the related information among children ages 12-17 is fairly limited. Birth order has been consistently found to be associated with diseases hypothesized to have an infectious aetiology but only few studies have examined its relationship with dental caries. The aims of this study were to determine the association of birth order and the sociodemographic background of subjects with caries and high caries experience among 16-year-old schoolchildren in Tumpat district, Kelantan. This was a case-control study. A total of 1087 16-year-old schoolchildren were examined intraorally for their caries status. They were categorized into three groups namely caries free (DMFS=0) mild caries (DMFS= 1-7) and high caries (DMFS $\geq$8) group based on DMFS score. Cases were the caries group and the controls were the caries free group. In each group, 163 subjects were selected by using simple random sampling. A questionnaire was used to obtain personal information of the subjects, birthweight and sociodemographic background. Analysis involved was ordinal logistic regression. The factor that was found to have association with caries and high caries experience determined using multiple ordinal logistic regression analysis was educational level of parents (OR=1.55, 95% CI: 1.06; 2.28). This study showed that birth order was not a significant factor associated with caries experience. Among the sociodemographic factors, only parent's educational level was found to be associated with caries and high caries experience.

Introduction

Sociodemographic factors such as age, race, sex and socioeconomic status (SES) are important variables to assess the contribution of biological, behavioural and cognitive factors to caries development and progression. A substantial body of literature documents the relationship between SES and health and consistently finds an inverse relationship between SES and the incidence and prevalence of disease (Reisine and Psoter, 2001). According to a systematic review by Reisine and Psoter (2001), the information about SES and caries in children ages 12-17 is fairly limited and several studies did not support a significant relationship between SES and caries prevalence. From National oral health survey of school children 1997 (NOHSS '97), showed that sociodemographic factors that were associated with dental caries among 16-year-olds were gender, educational levels of parents/guardians, ethnic group and region (Oral Health Division, 1998).

Birth weight, birth order, feeding practice, smoking during pregnancy, mother's health during pregnancy and age of mother at delivery were among the biological indicators that have been examined for the relationship with dental caries (Nicolau *et al.,* 2003). Birth order has consistently been associated with diseases hypothesized to have an infectious aetiology. Birth order may dictate the age of exposure to common childhood infections, under the assumption that firstborn

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children are not exposed until they enter school, while later-born children are exposed at an earlier age through other siblings (Mucci *et al.,* 2004).

Tumpat is one of the districts in the state of Kelantan, Peninsular Malaysia. The total population of this district is about 172,000. The ratio of dentist (government and private): population is 1: 28,676 (District Oral Health Services, 2004). The prevalence of caries among 16-year-olds in the year 2004 was 82.1% (Wan Salina*,* 2004) with a group of them experienced high caries. No study has been done so far to see the factors that may be associated with caries experience in this group of adolescents.

This study aims were to determine the association of the birth order and the sociodemographic background of subjects with caries and high caries experience among 16-year-old schoolchildren in Tumpat district, Kelantan.

Materials and methods

Study design

This is a case-control study to determine the associated factors for caries and high caries experience. This study was conducted from July 2004 to February, 2005.

Study area

This study was carried out in Tumpat, a coastal area in the North-eastern state of Kelantan, Peninsular Malaysia and is among the poorest district in the country. The district covers an area of about 16,800 km^2.

Selection of participants

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

In this study, those children with birth date that falls on 1st January 1988 till 31 December 1988 were included. Those with systemic diseases, on medication and wearing intraoral appliances were excluded. 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).

Sample size calculation

The sample size was calculated 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 (District 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 489 subjects.

Sampling method

Simple random sampling was applied to get 163 subjects for each group of caries free, mild caries and high caries group in this study.

Clinical examination

Intraoral examination was performed based on WHO recommended method (World Health Organization, 1997) by one investigator on a portable dental chair at school premises. Disposable mouth mirrors was used to aid vision and disposable probes used to remove food or debris from the tooth surfaces. Portable dental light was used and the examination was assisted by one assistant. No air-drying of the tooth surfaces was done.

DMF index was used in this study. Prior to the study, intra-examiner reliability was assessed by examining forty 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. Specially designed clinical forms were used to collect the data.

DMF index is the conventional method of defining dental caries in a population which measure either the number of teeth or the number of surfaces that are decayed, missing or filled as a result of caries which was developed in 1930s (Pitts *et al.*, 2003)*.* The fact that the same index is still in use for more than 60 years after its first description is indicative of both how successful it has been and how difficult it is to develop and gain acceptance for any alternative. Most data in dental caries studies has been collected using this index (Pitts *et al.*, 2003).

Sociodemographic background and birth order data

Sociodemographic background and birth order info was obtained by using a standard form both for subjects and their parents. Information obtained from the subjects was their date of birth, sex and race. Parents educational level, occupation, monthly income and birth order and birth weight of the subjects' information were

obtained from the parents. 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 was defined as the head of household occupation whereas the monthly household income was the total monthly income from the participating parent and spouse.

Ethical approval

Ethical clearance was obtained from The Research and Ethics Committee, Universiti Sains Malaysia. Permission from the Ministry of Education, Malaysia was also obtained to enable study on the school children.

Statistical analysis

Statistical Package for Social Sciences (SPSS) for Windows Version 11.0 and Intercooled Stata, Version 7.0 statistical software package were used for data entry and analysis respectively. 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.

The association of the independent factor (sociodemographic factors and birth order) with the outcome (dental caries and high caries experience) 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 obtained from comparison of mild caries or high caries versus caries free (for dental caries) and comparison of high caries versus caries free or mild caries (for high caries experience) are assumed to be equal. Therefore, it gives one odds ratio which is for each associated factor for caries and high caries experience.

Before proceeding with ordinal logistic regression analysis, ordinality assumption of proportional odds in ordinal logistic regression model was checked by comparing final model of the ordinal and multinomial (polythomous) logistic regression model by using likelihood ratio test (LR test). The insignificant p value indicated that assumption was met and appropriateness of using ordinal logistic regression analysis for this study. Analysis was done by 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 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. There was no interaction found among the significant associated factors and other possible factors. No multicollinearity problem was found between the variables. Linearity of the continuous variables was satisfactory.

Results for the fitness of the preliminary final model were obtained by using Hosmer-Lemeshow goodness of-fit test with two separate binary regressions approach. The first binary model was between caries free and "mild caries and high caries" whilst the second binary was between "caries free and mild caries" and high caries group.

At the multivariable analysis, other variables such as salivary factors and knowledge, attitude and practices were also included as independent variables in order to control their possible confounding effect. The adjusted odds ratio for the significant sociodemographic variable was presented with their 95%CI and p value.

Results

A total of 473 subjects participated in this study. 156 of them were caries free, 157 subjects were in the mild caries group while 160 of the subjects were in the high caries group. Sixteen of them were excluded because of absence from school or incomplete information.

In the analysis, a combination of categories was done when it was indicated (Table 1). For the race variable, it was divided 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). Monthly income was categorized into three groups: poverty (less than RM500), above poverty and below average income (RM500-RM1300) and average income (more than RM1300) during the analysis. Birth order was categorized into first and second or later child in the family (Nicolau *et al.*, 2003).

Results showed that by using simple ordinal logistic regression, the sociodemographic factors that have significant association with caries experience were sex, educational level of parents, parents' employment and household income. No significant association was found between race and caries experience. No significant association was also found between birth order and caries experience.

Parents' educational level was the only sociodemographic factor that showed significant association with caries experience at the multivariable level. Those subjects with parents who have education level of lower secondary education (SRP or equivalent and below) comparing to upper secondary education (SPM or equivalent and higher) have 1.55 times of higher odds of having higher level versus lower level of caries experience. It means that this odds is either the odds of having mild caries or high caries versus caries free (caries) or the odds of having high caries versus caries free or mild caries (high caries experience).

Table 1 Association between birth order and sociodemographic factors with caries experience

Variable	Caries free, n=156 n (%)	Mild caries n=157 n (%)	High caries n=160 n (%)	Crude OR[a]	95% CI[a]	χ^2 (df)[a]	p value[a]	Adjusted OR[b]	95% CI[b]	χ^2 (df)[b]	p value[b]
Parents education level											
- Upper secondary	81 (51.9)	62 (39.5)	50 (31.3)	1.00		14.08 (1)	<0.001	1.00		5.10 (1)	0.024
- Lower secondary	75 (48.1)	95 (60.5)	110 (68.7)	1.92	1.36, 2.69			1.55	1.06, 2.28		
Sex											
- Male	65 (41.7)	42 (26.8)	43 (26.9)	1.00		8.08 (1)	0.005				
- Female	91 (58.3)	115 (73.2)	117 (73.1)	1.69	1.18, 2.43						
Race											
- Malay	149 (95.5)	150 (95.5)	152 (95.0)	1.00		0.05 (1)	0.827				
- Others	7 (4.5)	7 (4.5)	8 (5.0)	1.09	0.49, 2.41						
Parents' occupation											
- Government	37 (23.7)	26 (16.6)	17 (10.6)	1.00		9.99 (3)	0.106				
- Private	9 (5.8)	19 (12.1)	9 (5.6)	1.77	0.88, 3.53		0.002				
- Self-employed	106 (67.9)	103 (65.6)	128 (80.0)	2.06	1.30, 3.24		0.083				
- Not working	4 (2.6)	9 (5.7)	6 (3.8)	2.19	0.90, 5.33						
Monthly household income											
- < RM500	92 (59.0)	98 (62.4)	115 (71.9)	1.00		8.47 (2)	0.129				
- RM500- RM1300	44 (28.2)	46 (29.3)	37 (23.1)	0.75	0.51, 1.09		0.007				
- > RM1300	20 (12.8)	13 (8.3)	8 (5.0)	0.43	0.23, 0.79						
Birth order											
- First	31 (19.9)	27 (17.2)	28 (17.5)	1.00		0.30 (1)	0.586				
- Others	125 (80.1)	130 (82.8)	132 (82.5)	1.13	0.73, 1.74						

[a] simple ordinal logistic regression, [b] multiple ordinal logistic regression

Discussion

In the Eighth Malaysia Plan, the state of Kelantan is categorized into less developed states because of its high incidence of poverty (18.7%) which was the highest in Peninsular Malaysia. In the year 2001, Tumpat district had the second highest number of head of household income of less than RM340/month (Pusat Maklumat Negeri Kelantan, 2005) indicating Tumpat as among the poorest district in Malaysia. The prevalence of caries was high in this district (Wan Salina, 2004).

Many studies have shown that dental caries is concentrated in socially deprived people, and oral diseases are higher among low-income and or less-educated groups possibly due to lack of dental services (Kumar and Green, 2005). Parental education is among the indicators used in measuring socioeconomic status and it was found to be significantly associated with caries experience in this study. Subjects with parents' educational level of lower secondary education and below (SRP or equivalent and below) have higher odds of having higher level of caries experience compared to parents with upper secondary education (SPM or equivalent and above). This finding was consistent with National oral health survey of school children 1997 (NOHSS '97) in Malaysia (Oral Health Division, 1998) and also by other studies (Sgan-Cohen *et al.*, 1984; Lachapelle-Harvey and Sevigny, 1985) where caries prevalence and severity differ significantly between educational levels of parents or guardians, and were consistently highest among the parents with lower secondary education or below. This finding was also in agreement with Nicolau *et al.* (2005) who found that adolescents of mother with lower educational level have *OR* of 2.10 of having a high DMFT. However, this was in contrast with the findings of Nicolau *et al.* (2003) who found that both father's and mother's educational levels were not significant factors for having high DMFT among 13-year-old Brazilians. According to Petersen (2005), the effect of educational background on dental caries was found to be particularly strong when the disease prevalence was high.

Sex, race, parents' occupation and household income were not statistically significant factors for caries experience in this study. This was in accordance with findings of Rugg-Gunn *et al.* (1984). Nevertheless, findings among 14-15 year-old French adolescents showed that the variables which significantly contribute to explain DMFS were age and sex (Tubert-Jeanin *et al.*, 1994). Dental caries prevalence, mean DMFXT and DMFXS scores were significantly different between males and females age 12 and 16 year-olds examined in NOHSS '97, where females demonstrated higher caries experience than males (Oral Health Division, MOH Malaysia, 1998). Among 12-year-old and 15-year-old Jamaican school children, females had higher mean DMFT scores than males with the difference of DMFT at

age 15 years being statistically significant (Warpeha *et al.*, 2001). In a study among 15-19 year-old Saudis in Riyadh and Qaseem regions, there was no significant differences of DMFT scores between boys and girls in Riyadh, whereas in Qaseem the DMFT score was significantly higher in males compared to females (Al-Dasori *et al.*, 2003).

Based on the NOHSS '97 (Oral Health Division, 1998), dental caries status differs significantly between different ethnic groups in Malaysia. Among adolescent aged 16-year-olds, the Indian or Pakistani group exhibited the lowest caries experience whilst the highest caries experience was seen amongst the Kadazans and the other Bumiputera groups. According to Forshee and Storey (2004), race or ethnicity is a strong predictor of DMFS among adolescents, but usually among the older age group of children. However, results from this study revealed no statistically significant association between race and caries experience. The insignificant finding may be due to small numbers of study subjects from other races compared to Malays subjects. Being the majority ethnic group in Tumpat, and with only small proportion of other races in this district, it is understandable why Malays formed majority of the sample.

Adolescents from affluent families in contrast to less affluent families may be raised in good quality housing with basic amenities that prevent infections and diseases. They may be offered more opportunities to develop good oral health behaviours, have an income allowing access to a variety of oral hygiene items and make healthy choices in their diet, thus leading to better oral health (Nicolau *et al.,* 2003). In a study among Brazilian adolescents, those with low family income were more likely to experience high levels of caries with odds ratio of 2.22 (Nicolau *et al.,* 2003). Moyses *et al.* (2003) also found an association between family income and caries experience among 12-year-olds in Curitiba, Brazil. However, there was a lack of association between caries experience and both parents occupation and family income in this study. This is similarly found among 15-year-old Israelis (Sgan-Cohen *et al.,* 1984), where parents' occupation was not a significant factor. Possible reasons for the insignificant findings in this study might be due to the lack of variation in parents' occupation and household income among the study groups. Majority of the parents were self-employed with a median income of about RM 500 in all groups.

It has been found that the first child in a family often show a better oral health compared to their siblings (Nicolau *et al.*, 2003; Mucci *et al.*, 2004; Nicolau *et al.*, 2005). Nicolau *et al.* in 2003 and 2005 found that those who were second or later in the family were statistically significantly more likely to have high DMFT with *OR* of 2.22 and 1.90 respectively. It may be because the child is given full attention from their parents while still without siblings. Nevertheless, results from this study showed that birth order has insignificant association with caries. Our results did not support the findings from previous studies on the association between birth order and dental caries. Further study with better design that examine each sibling in caries or a cohort study may provide more accurate information.

Conclusions

This study shows that birth order and sociodemographic factors has no significant association with dental caries except for parents' education level. School children whose parents have lower education level have higher chance of having caries and high caries experience.

Acknowledgement

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