Effect of Family Structure and Behavioral and Eyesight Problems on Caries Severity in Pupils by Using an Ordinal Logistic Model

Yunes JAHANI [1], *Mohammad Reza ESHRAGHIAN [1], Abbas Rahimi FOROUSHANI [1], Keramat NOURIJELYANI [1], Kazem MOHAMMAD [1], Arash SHAHRAVAN [2], Mahin ALAM [3]

1. Dept. of Epidemiology and Biostatistics, School of Public Health, Tehran University of Medical Sciences, Tehran, Iran
2. Kerman Oral and Dental Diseases Research Center, Kerman University of Medical Sciences, Kerman, Iran
3. Youth and Schools Health Unit, Deputy of Hygiene, Kerman University of Medical Sciences, Kerman, Iran

*Corresponding Author: Tel: +98 021 88989127 Email: eshraghianmr@yahoo.com

Abstract

Background: Dental caries is one of the most preventable yet prevalent chronic diseases worldwide. Our objective was to evaluate the effect of family structure and behavioral and eyesight problems as they relate to caries severity in schoolchildren.

Methods: This research was carried out on 845 primary schoolchildren aged 9 yr in Kerman, Iran, in 2012. Ten variables, including health records, family structure information and a dmft/DMFT index, were collected. Children were categorized into three groups based on the WHO caries severity classification. Low caries level was defined as dmft/DMFT<2.6, moderate as dmft/DMFT of 2.7-4.4 and high as dmft/DMFT>4.4. The Cochran–Armitage test and ordinal logistic regression were employed for data analysis.

Results: Almost half of pupils had moderate or high caries severity. The odds of being in a higher caries severity category in pupils with behavioral problems (OR=2.37, 95% CI: 1.29-4.38) and girls (OR=1.6, 95% CI: 1.22-2.06) were higher than in other categories. In addition, pupils with eyesight problems (OR=0.58, 95% CI: 0.37-0.90) and overweight pupils (OR=0.46, 95% CI: 0.31-0.71) had lower caries severity than others. The effects of parents' education, birth rank, living with parents and consanguineous relationship between parents were not significant on caries severity (*P*>0.05).

Conclusions: Female pupils with behavioral problems were at a higher risk of caries severity than other pupils. These pupils need to be educated and coached on proper dental care. In addition, overweight pupils and those with eyesight problems had less caries severity than others. Family structure in this study did not have an effect on the severity of dental caries.

Keywords: Behavioral problems, Caries severity, Family structure, Ordinal logistic regression, Schoolchildren

Introduction

Dental caries is one of the most prevalent chronic diseases worldwide. It is the primary cause of oral pain and tooth loss (1). Oral and dental hygiene are considered so critical to the fulfillment and promotion of health that it has been one of the key areas of medical focus in the 21st century (2). Dental caries is still the most common chronic childhood disease, five times more common than asthma and seven times more common than hay fever. Nearly 20% of 2-4-year-old children have

clinically detectable caries, and by age 17, nearly 80% of young people have one or more teeth with caries (3). High prevalence of dental caries has been reported in many similar countries in Asia. Iran, like other developing countries, is on the edge of rise in caries prevalence (4). The majority of studies within the last 10 years on primary schoolchildren in Iran have shown that caries prevalence in pupils is 35–85% (4-8).

Dental caries is a complex disease governed by a large number of factors (9). It is very important to prevent dental caries, but this is not likely to occur unless the available scientific knowledge about changing the etiological factors of the disease is applied (10).

Carries risks include biological, environmental, behavioral, and lifestyle-related factors. The approach to primary prevention should be based on common risk factors (1). Caries-active children had significantly more behavioral problems than caries-free children (11).

With respect to the home environment, some studies have verified the influence of family on the oral health outcomes of children, and contend that their families play a central role in promoting their oral health (12, 13). Since children are the most susceptible groups to tooth decay and have the highest rate of incidence, determining dental caries indices and its influencing factors is one of the foremost aims of various research studies in different countries. In addition, statistical modeling plays an important role in understanding caries risk factors (14).

Some researchers have reported that caries rate is not generally approximated by a normal distribution and common analyses such as t-test and linear regression are not appropriate (14, 15). Categorizing of dental caries indices and use of ordinal logistic regression is a method to solve this problem (16).

This study evaluated the effects of family structure and behavioral and eyesight problems on caries severity by using an ordinal logistic model in 9-year-old schoolchildren living in Kerman, the largest and most important city in the southeast of Iran, in 2012.

Materials and Methods

This research was carried out on 845 schoolchildren aged 9 years in Kerman, Iran, in 2012. In Iran, trained school nurses regularly examine health information of pupils in primary schools. Dental examination was carried out by school nurses to detect dental caries in accordance with WHO criteria (17). These health records and registered family structure information were used for selected pupils. Schoolchildren were selected through cluster random sampling technique. Nineteen schools were considered as clusters selected by random selection and all the schoolchildren in these schools were included in this study as samples.

In this research, caries severity was used as the dependent variable. The dmft/DMFT was calculated as sum of total decayed (d/D), missing (m/M) and filled (f/F) teeth for primary and permanent teeth. Then the children were categorized into three groups on the basis of WHO caries severity classification (2). Low caries level was defined as dmft/DMFT≤2.6, moderate caries level as dmft/DMFT of 2.7-4.4 and high caries level as dmft/DMFT>4.4.

The family structure of pupils studied here included consanguineous relationship between parents (yes/no), living with parents (with both of them/with one or none of them), birth rank (one, two and three or more) and parents' education (high school degree or lower/university). The effect of eyesight problems (yes/no) such as blurred vision and wearing glasses, behavioral problems (yes/no) such as stress and nail biting, gender (boy/girl) and BMI (underweight, normal, at risk of overweight, and overweight) were also investigated in the study.

Each pupil's BMI (Body Mass Index) was calculated as weight in kilograms divided by the square of the height in meters (kg/m^2). Standardized percentile curves of BMI in Iran were used. According to these curves underweight condition is defined as under the 5th percentile curve, normal as between the 5th and 85th percentile, at risk of being overweight as higher than the 85th and lower than the 95th percentile and overweight as higher or equal to the 95th percentile (18).

Reliability and validity

To evaluate the examiner's (i.e., school nurses) reliability in carrying out dental examinations, three school nurses and twenty pupils from their schools were randomly selected. The dental examinations were carried out on all twenty pupils by each of these school nurses. The Fleiss' kappa (19), for evaluating agreements between three school nurses for caries severity, was found to be 0.87, indicating a high level of agreement between them. In addition, to assure the validity of the nurses' findings, a dentist conducted dental examinations on the same twenty pupils. Then the results were compared with those of school nurses. Cohen's kappa (k) (19), between the dentist and each school nurse was high (k =0.89 for examiner 1, k =0.90 for examiner 2 and k =0.81 for examiner 3), indicating that the results of examinations by school nurses were valid.

Statistical analysis

Frequencies and percentages of caries severity were reported according to the variables of this study. In univariate analysis, the Cochran–Armitage test was used to investigate the relationship between caries severity and the variables of this study. In addition, the multiple ordinal logistic regression was used because the caries severity, this study's dependent variable, was an ordinal variable (16). This model shows the effect of each significant factor adjusted for others. The final model contained only factors that were significant at the level of $P \leq 0.05$. The adjusted odds ratios (AOR) of being in a higher caries severity category and its 95% confidence interval were reported in relation to the multiple ordinal logistic model. Data were analyzed using STATA 8.0.

Results

Of 845 pupils in this study, 56% were female. The majority of the pupils (97%) lived with both of their parents. About 30% of their parents had consanguineous relationship. A total of 27.6% of pupils had a birth rank of 3 or more, 4.3% of them had one behavioral problem and 10.5% of them had eyesight problems. The weight (BMI) of 69.6% of pupils was normal, 22.6% of their mothers and 28.9% of their fathers had a university degree.

About half of the pupils had moderate or high caries severity. The caries prevalence (low, moderate and high) according to the variables of the study is presented in Table 1. In univariate analysis, it was found that the relationship between gender and caries severity was significant ($P<0.0001$), i.e. 38.7% of girls were in the high caries severity category versus only 25.5% of boys. In addition, the overweight pupils had the least caries severity than others ($P<0.0001$). Behavioral problems were an effective factor in dental caries ($P=0.02$). Approximately 42% of pupils with any behavioral problems were in high caries severity category but only 32.5% of other pupils were in this category. Also, eyesight problems were related to dental caries ($P=0.001$). Table 1 shows that the family structure (parent's education, birth rank, living with parents, consanguineous relationship between parents) had no significant effect on dental caries ($P>0.05$).

Table 2 shows the results of fitting multiple ordinal logistic regression to caries severity. Other factors, which are not presented in Table 2, were not significant ($P>0.05$). This model shows the effect of each significant factor adjusted for others. It was shown that the odds of being in a higher caries severity category in pupils that had eyesight problems was 0.58 (95% CI: 0.37-0.90) times lower than others ($P=0.01$). In addition, the odds of being in a higher caries severity category in overweight pupils was 0.46 (95% CI: 0.31-0.71) times lower than those with normal weight ($P<0.0001$). Both of these recent results indicated that obesity and eyesight problems were factors affecting dental caries. In addition, girls (OR=1.6, 95% CI: 1.22-2.06) and pupils with behavioral problems (OR=2.37, 95% CI: 1.29-4.38) had higher caries severity. Therefore, gender and behavioral problems in the present study were risk factors for dental caries.

Table 1: Caries severity prevalence according to the variables in 9-year-old pupils in Iran

Variables		Caries severity[1]			P-value[2]
		Low	Moderate	High	
Gender	Boy	197 (53.0)[3]	80 (21.5)	95 (25.5)	< 0.0001
	Girl	206 (43.6)	84 (17.7)	183 (38.7)	
Birth rank	1	163 (46.3)	71 (20.2)	118 (33.5)	0.46
	2	125 (48.1)	47 (18.1)	88 (33.8)	
	≥3	115 (49.4)	46 (19.7)	72 (30.9)	
Mother's education	High school and less	315 (48.2)	126 (19.3)	213 (32.5)	0.63
	University	88 (46.1)	38 (19.9)	65 (34.0)	
Father's education	High school and less	291 (48.4)	109 (18.2)	201 (33.4)	0.92
	University	112 (45.9)	55 (22.5)	77 (31.6)	
Living with parents	Both of them	387 (47.2)	162 (19.8)	271 (33.0)	0.22
	One or none of them	16 (64.0)	2 (8.0)	7 (28.0)	
Consanguineous relationship between parent	Yes	111 (44.6)	54 (21.7)	84 (33.7)	0.40
	No	292 (49.0)	110 (18.4)	194 (32.6)	
Eyesight problems	Yes	55 (61.8)	18 (20.2)	16 (18.0)	0.001
	No	348 (46.0)	146 (19.3)	262 (34.7)	
Behavioral problems	Yes	8 (22.2)	13 (36.1)	15 (41.7)	0.02
	No	395 (48.8)	151 (18.7)	263 (32.5)	
BMI	Underweight	9 (40.9)	4 (18.2)	9 (40.9)	< 0.0001
	Normal	263 (44.8)	112 (19.0)	213 (36.2)	
	At risk overweight	66 (50.8)	27 (20.8)	37 (28.4)	
	Overweight	65 (61.9)	21 (20.0)	19 (18.1)	
Total		403 (47.7)	164 (19.4)	278 (32.9)	-

1- Low caries level was defined as dmft/DMFT<2.6, moderate caries level as dmft/DMFT of 2.7-4.4 and high caries level as dmft/DMFT>4.4
2- Cochran–Armitage test
3- Number (row percentage)

Table 2: Multiple ordinal logistic regression analysis for adjusted effective factors on caries severity

Variables		Adjusted Odds Ratio[1]	95% CI[2]	P-value
Gender	Boy	1	-	-
	Girl	1.6	1.22 -2.06	0.001
Eyesight problems	No	1	-	-
	Yes	0.58	0.37-0.90	0.01
Behavioral problems	No	1	1	1
	Yes	2.37	1.29-4.38	0.006
BMI	Normal	1	-	-
	Underweight	1.33	0.59 - 2.98	0.48
	At risk overweight	0.83	0.57 - 1.20	0.31
	Overweight	0.46	0.31 - 0.71	< 0.0001

1- The adjusted odds ratio of being in a higher caries severity category
2- Confidence Interval

Discussion

Dental caries (decay) is the primary cause of severe pain, anxiety and sleep loss and is a major health problem, particularly for disadvantaged populations (20). It is very important to prevent dental caries, but this is unlikely to happen unless the risk factors are known and steps are proactively taken to ensure the children's optimum dental health. Therefore, in this study, an attempt was made to find some of the risk factors and identify those children at greatest risk of dental caries.

In this research, behavioral problems had a significant effect on caries severity. Almost 80% of pupils with behavioral problems had moderate and high caries severity. The odds of being in a high caries severity category in pupils with behavioral problems, including stress or nail biting, was greater than in others. Therefore, preventive programs, especially in schools, are necessary in order to avoid a further increase in behavioral problems. The results of a study by Williamson et al. in the United States showed that caries-active children had significantly more behavioral problems compared to caries-free children (11). These findings imply that pupils with behavioral problems need more attention to dental care.

In the present study, eyesight problems had a significant effect on dental caries. The percentage of high caries severity in pupils with eyesight problems was less than others. Therefore, eyesight problems had an inverse effect on oral conditions. Perhaps that is why pupils who wear glasses or have blurred vision tend to pay more attention to hygiene, a critical component to dental care. In a study on 593 schoolchildren, Bhavasar and Damle reported the lowest rate of caries among pupils that had an eyesight problem (21), consistent with the results of this study. In Greeley's study, no significant relationship was found between dental caries and eyesight problems (22). These findings indicate that more research should be carried out to better understand these causal factors.

In the present study, gender was an effective factor in caries severity. The odds of being in a higher caries severity category for girls were higher than that for boys. Huew et al. in a study on 791 schoolchildren in Libya, showed that dental caries was more prevalent amongst girls (23). In a study on 5116 pupils 5-12 years of age in Greece, Gatou et al. reported that gender preserved its predictive value on caries experience, i.e. girls had higher odds of caries experience than boys (OR=1.31) (24). In addition, the results of this study are consistent with those of some other studies in Iran and other countries (25-27). The results of this study were expected since permanent dentition erupts 2–10 months earlier in girls than in boys (28, 29). Therefore, girls need a greater degree of dental care.

This study showed that an increase in BMI is associated with a decrease in dental caries severity. Pupils with low BMI were at a higher risk of being in a higher caries severity than others. Sadeghi et al. in Isfahan, Iran, reported that caries prevalence in pupils with low BMI was higher than others (7). In a study by Mohammadi et al. in Kerman, Iran, pupils in primary schools underwent dental examination and BMI was evaluated (30). The authors reported that obese pupils had less caries severity than others. Also, the results of this study are consistent with those of some studies in other countries (3, 31-33). The nature of the hypothesized protective effect of weight on dental caries is still obscure. Low BMI may be associated with eating habits that have a negative impact on dental health; however, further longitudinal studies are necessary.

Living with one or none of the parents, had no significant effect on caries severity in our study. As minority of participants are living with 1 or none of their parents, in other words most of the pupils are living with both of their parents, therefore further detailed studies are needed to make any conclusion about the relation between the effect of this factor on caries severity .

In addition, in the present study, consanguineous relationship between the parents, parents' education and birth rank, had no significant effect on caries severity in the subjects. Therefore, the family structure in this study was not an effective factor in dental caries.

One of the limitations of the present study included its cross-sectional nature, which limits the ability to identify causative factors. Further longitudinal studies are required to confirm possible cause-and-effect relationships. In addition, no information was available about nutritional factors and brushing habits of the subjects, which should be considered in future studies.

Conclusion

The findings of this study indicated that pupils with behavioral problems and female pupils were at a greater risk for severe caries than others. These pupils need more attention to dental care. In addition, overweight pupils and those with eyesight problems, such as blurred vision and wearing glasses, had less caries severity than others. Family structure in this study was not an effective factor in dental caries.

Ethical considerations

Ethical issues (Including plagiarism, Informed Consent, misconduct, data fabrication and/or falsification, double publication and/or submission, redundancy, etc) have been completely observed by the authors.

Acknowledgments

References

1. Selwitz RH, Ismail AI,Pitts NB (2007). Dental caries. *Lancet,* 369:51-9.
2. Petersen PE (2003). The World Oral Health Report 2003: continuous improvement of oral health in the 21st century - the approach of the WHO Global Oral Health Programme. *Community Dent Oral Epidemiol,* 31 Suppl 1:3-23.
3. Kopycka-Kedzierawski DT, Auinger P, Billings RJ,Weitzman M (2008). Caries status and overweight in 2- to 18-year-old US children: findings from national surveys. *Community Dent Oral Epidemiol,* 36:157-67.
4. Kazerouni K, Mohammadi N, Ansari G,Kamali Z (2005). The effects of socio-economic status on dental caries incidence in a group of primary school children, Tehran-2000. *J Dent Sch,* 22:51-59.
5. Motlagh MG, Khanik GRJ,Adiban H (2007). Investigation of dental caries prevalence among 6-12 year old elementary school children in Andimeshk,Iran. *J Med Sci,* 7:116-120.
6. Momeni A, Mardi M,Pieper K (2006). Caries prevalence and treatment needs of 12-year-old children in the Islamic Republic of Iran. *Med Princ Pract,* 15:24-8.
7. Sadeghi M,Alizadeh F (2007). Association between Dental Caries and Body Mass Index-For-Age among 6-11-Year-Old Children in Isfahan in 2007. *JODDD,* 1:119-124.
8. Sadeghi M, Lynch CD,Arsalan A (2011). Is there a correlation between dental caries and body mass index-for-age among adolescents in Iran? *Community Dent Health,* 28:174-7.
9. Primosch RE (1982). Effect of family structure on the dental caries experience of children. *J Public Health Dent,* 42:155-68.
10. Poureslami HR,Amerongen WEV (2009). Early Childhood Caries (ECC): an infectious transmissible oral disease. *Indian J Pediatr,* 76:191-4.
11. Williamson R, Oueis H, Casamassimo PS,Thikkurissy S (2008). Association between early childhood caries and behavior as measured by the Child Behavior Checklist. *Pediatr Dent,* 30:505-9.
12. Levin KA,Currie C (2010). Adolescent toothbrushing and the home environment: sociodemographic factors, family relationships and mealtime routines and disorganisation. *Community Dent Oral Epidemiol,* 38:10-8.
13. Locker D, Jokovic A, Stephens M, Kenny D, Tompson B,Guyatt G (2002). Family impact of child oral and oro-facial conditions. *Community Dent Oral Epidemiol,* 30:438-48.

14. Preisser JS, Stamm JW, Long DL,Kincade ME (2012). Review and recommendations for zero-inflated count regression modeling of dental caries indices in epidemiological studies. *Caries Res,* 46:413-23.

15. Solinas G, Campus G, Maida C, Sotgiu G, Cagetti MG, Lesaffre E,Castiglia P (2009). What statistical method should be used to evaluate risk factors associated with dmfs index? Evidence from the National Pathfinder Survey of 4-year-old Italian children. *Community Dent Oral Epidemiol,* 37:539-46.

16. Bender R,Grouven U (1997). Ordinal logistic regression in medical research. *J R Coll Physicians Lond,* 31:546-51.

17. (1997). *World Health Organization.Oral Health Surveys:Basic Methods.* 4th ed., Geneva:WHO.

18. Hosseini M, Carpenter RG,Mohammad K (1999). Body mass index reference curves for Iran. *Ann Hum Biol,* 26:527-35.

19. Sim J,Wright CC (2005). The kappa statistic in reliability studies: use, interpretation, and sample size requirements. *Phys Ther,* 85:257-68.

20. Arora A, Scott JA, Bhole S, Do L, Schwarz E,Blinkhorn AS (2011). Early childhood feeding practices and dental caries in preschool children: a multi-centre birth cohort study. *BMC Public Health,* 11:28.

21. Bhavsar JP,Damle SG (1995). Dental caries and oral hygiene amongst 12-14 years old handicapped children of Bombay, India. *J Indian Soc Pedod Prev Dent,* 13:1-3.

22. Greeley CB, Goldstein PA,Forrester DJ (1976). Oral manifestations in a group of blind students. *ASDC J Dent Child,* 43:39-41.

23. Huew R, Waterhouse PJ, Moynihan PJ,Maguire A (2011). Prevalence and severity of dental caries in Libyan schoolchildren. *Int Dent J,* 61:217-23.

24. Gatou T, Koletsi Kounari H,Mamai-Homata E (2011). Dental caries prevalence and treatment needs of 5- to 12-year-old children in relation to area-based income and immigrant background in Greece. *Int Dent J,* 61:144-51.

25. Moghimbeigi A, Eshraghian MR, Mohammad K,McArdle B (2008). Multilevel zero-inflated negative binomial regression modeling for over-dispersed count data with extra zeros. *J Appl Stat* 35:1193-1202.

26. Gerdin EW, Angbratt M, Aronsson K, Eriksson E,Johansson I (2008). Dental caries and body mass index by socio-economic status in Swedish children. *Community Dent Oral Epidemiol,* 36:459-65.

27. Saied-Moallemi Z, Virtanen JI, Tehranchi A,Murtomaa H (2006). Disparities in oral health of children in Tehran, Iran. *Eur Arch Paediatr Dent,* 7:262-4.

28. Parner ET, Heidmann JM, Vaeth M,Poulsen S (2001). A longitudinal study of time trends in the eruption of permanent teeth in Danish children. *Arch Oral Biol,* 46:425-31.

29. Wedl JS, Danias S, Schmelzle R,Friedrich RE (2005). Eruption times of permanent teeth in children and young adolescents in Athens (Greece). *Clin Oral Investig,* 9:131-4.

30. Mohammadi TM, Hossienian Z,Bakhteyar M (2012). The association of body mass index with dental caries in an Iranian sample of children. *J Oral Health Oral Epidemiol,* 1:29-35.

31. Macek MD,Mitola DJ (2006). Exploring the association between overweight and dental caries among US children. *Pediatr Dent,* 28:375-80.

32. Norberg C, Stalin UH, Matsson L, Thorngren-Jerneck K,Klingberg G (2012). Body mass index (BMI) and dental caries in 5-year-old children from southern Sweden. *Community Dent Oral Epidemiol,* 40:315-22.

33. Oliveira LB, Sheiham A,Bonecker M (2008). Exploring the association of dental caries with social factors and nutritional status in Brazilian preschool children. *Eur J Oral Sci,* 116:37-43.

Available at: http://ijph.tums.ac.ir