What explains socioeconomic inequality in dental caries among school children in west of Iran? A Blinder-Oaxaca decomposition

Ali Kazemi Karyani PhD[1]⊙, Mohammad Habibullah Pulok PhD[2], Sina Ahmadi PhD[3], Shahin Soltani PhD[1], Zhila Kazemi MSc[4], Enayatollah Homaie Rad PhD[5], Mohammad Ebrahimi PhD[1], Satar Rezaei PhD[1]⊙

Original Article

Abstract

BACKGROUND AND AIM: Dental caries among children is considered as a main public health concern in most of the countries over world and its prevalence is widespread in low-income countries like Iran. The aim of this study was to measure socioeconomic-related inequality in poor decayed, missing, filled (DMF) index and identify the determinants among school children in west of Iran.

METHODS: A survey was carried out among school children aged 12 to 15 years in Kermanshah City, Iran, in 2018, to collect data on dental caries, demographic characteristics, and socioeconomic status (SES). A total of 1457 students were included in the analysis of this cross-sectional study. Logistic regression analysis examined the association of poor DMF index with the socioeconomic and behavioral determinants. We used the relative index of inequality (RII) and the slope index of inequality (SII) to measure wealth-related inequality in poor DMF index. The Blinder-Oaxaca (BO) decomposition technique was also employed to identify the factors of the difference in poor DMF prevalence between the poorest and the richest groups.

RESULTS: The overall and age-adjusted prevalence of poor DMF index was 36.92% [95% confidence interval (CI): 34.48-39.43] and 37.32% (95% CI: 34.64-40.08), respectively. The SII and RII indicated that the poor DMF index was mainly prevalent among poorer children. The absolute gap (%) in the incidence of poor DMF index between children from the richest and the poorest groups was 22.50. The BO results showed that the most important factors affecting the difference in poor DMF index were mother's education (18.23%), being girl (6.12%), and visit to dentist (2.93%).

CONCLUSION: There was a significant pro-rich distribution of poor DMF index among school children in the capital of Kermanshah Province. Interventions aimed at increasing mother's education and good oral health behavior among poorer children could contribute to decline of the difference in poor DMF index between the highest and the lowest SES groups.

KEYWORDS: Inequality; Dental Caries; Adult Children; Socioeconomic Factors; Iran

Citation: Kazemi Karyani A, Habibullah Pulok M, Ahmadi S, Soltani S, Kazemi Z, Homaie Rad E, et al. **What explains socioeconomic inequality in dental caries among school children in west of Iran? A Blinder-Oaxaca decomposition.** J Oral Health Oral Epidemiol 2019; 8(3): 153-60.

Oral health is a fundamental component of overall health, wellbeing, and quality of life.[1] One of the most important oral health indicators is decayed, missing, filled teeth (DMFT) index, which is used as the oral health assessment criteria in most epidemiological studies.[2,3] DMFT is the mean number of DMF teeth in a group of individuals and its total score ranges from 0 to 28 or 32.[4,5] Dental caries among children is a major public health problem.[1] According to

1- Assistant Professor, Research Center for Environmental Determinants of Health, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran
2- Postdoctoral Research Fellow, Nova Scotia Health Authority and Dalhousie University, Halifax, Nova Scotia, Canada
3- Assistant Professor, Department of Social Welfare Management, University of Social Welfare and Rehabilitation Sciences, Tehran, Iran
4- Lecturer, Research Center for Environmental Determinants of Health, Health Institute, Kermanshah University of Medical Sciences, Kermanshah, Iran
5- Assistant Professor, Social Determinants of Health Research Center, Guilan University of Medical Sciences, Rasht, Iran
Correspondence to: Satar Rezaei PhD
Email: satarrezaei@gmail.com

the World Health Organization (WHO), about 60%-90% of school children worldwide have dental caries[4] and this disease is more prevalent in low- and middle-income countries.[6] The number of children who suffer from pain and discomfort and miss school lessons is increasing in developing countries. It is estimated that more than 51 million school hours are lost each year worldwide due to dental-related illness.[7] Dental health indices could be hallmarks of socioeconomic conditions[2] and oral health inequalities exist within and between different population groups through the life course and are associated with socioeconomic status (SES).[8]

Previous studies have shown that a significant inequality in oral health outcomes exists across social groups. Oral health inequalities are caused by a broad range of interacting biological, socio-behavioral, psychosocial, societal, and political factors that create 'the conditions in which people are born, grow, live, work, and age' - the so-called social determinants of health.[3] SES is highly associated with oral health condition.[9,10] Although the effect of SES on oral health has been extensively examined, there is little information on socioeconomic-related inequalities in oral health and its main determinants among school children in Iran. Then, the aim of this study was to quantify the extent of socioeconomic inequality in poor DMFT index and identify the main factors that explain this inequality among 12-15-year-old students in Kermanshah City, western Iran.

Methods

A cross-sectional survey was conducted out from October to November 2018 in Kermanshah City, the capital of Kermanshah Province. The study population was school children aged 12 to 15 years. The multistage sampling technique was employed to choose the sample population. We first divided the Kermanshah City into five areas of central, western, eastern, southern, and northern to select our sample. Secondly, at least one girl's school and one boy's school were randomly selected from each area. Finally, all school children in each school were included using census method. If the number of sample in a school was not sufficient, more than one school was included in the study. Finally, 14 schools (8 girl's schools and 6 boy's schools) were selected for data collection in the survey. Data were collected by public health students (bachelor of science) who were trained by the authors. A total of 1577 school children were selected to complete the questionnaire. Due to missing data, 120 observations were excluded which resulted in a final sample of 1457 school children for statistical analysis.

The questionnaire had two parts: sociodemographic part and status of dental caries and dental care utilization. The first part consisted of questions about age, gender of child, sex of household head, father's education, mother's education, and household durable assets (house, car, computer/laptop, access to internet, freezer, dishwasher, TV, and etc.). The second part included questions on regular brushing, visiting dentist in every six months, and number of DMFT of the school children.

The prevalence of poor DMFT index (as a binary variable) was used as an outcome variable of this study; we followed Moradi et al.[8] to construct this variable. We first gave more weight to missed teeth (multiplied by 2), less weight to filled teeth (multiplied by 0.5), and counted decayed teeth multiplied by 1. Then a cut-off point was used to define poor and good oral health condition and the cut-off point was set at the mean of DMF score. The subjects with score above cut-off point were considered as poor DMF index and the rest of subjects with score less than mean of DMF score were defined as good DMF index. The principal component analysis (PCA) was used to develop the wealth index.[11] The items included in the wealth index are having car, color TV, computer/laptop, cell phone, freezer,

dishwasher, microwave, vacuum cleaner, motorcycle, and bicycle, number of rooms per capita, type of house ownership, and house size per square meter. We divided households into five categories (quintiles) from the poorest to the richest based on wealth score. We used age of children, gender of children, gender of household head, mother's education, father's education, regular brushing, regular dentist visit per 6 months, and wealth index as the determinants of prevalence of poor DMF index in the study.

The slope index of inequality (SII) and relative index of inequality (RII) were used to measure socioeconomic-related inequality in poor DMF score.[12] We also employed multivariate logistic regression model to examine the association between poor DMF score and independent variables. Finally, the Blinder-Oaxaca (BO) decomposition approach was used to quantify the contribution of each dependent variable.[13-16] We used the following formulas to estimate the gap between the poorest and the richest in poor DMF: (in these equations P is the poorest and R is the richest)

$$y_i = \begin{cases} \beta^P x_i + \varepsilon_i^P & \text{if P} \\ \beta^R x_i + \varepsilon_i^R & \text{if R} \end{cases}$$

The gap between the mean outcomes, y^P and y^R, is equal to:

$$y^R - y^P = \Delta x \beta^P + \Delta \beta x^R$$

Where

$$\begin{cases} \Delta x = x^R - x^P \text{ and } \Delta \beta = \beta^R - \beta^P \\ \\ y^R - y^P = \Delta x \beta^R + \Delta \beta x^P \end{cases}$$

It can be written as follow:

$$y^R - y^P = \Delta x \beta^P + \Delta \beta x^P + \Delta x \Delta \beta = E + C + CE$$

Where x^R and x^P are the average independent variables for the richest (Rich group in above formula) and the poorest (Poor group in above formula). The mean difference in the outcome variable (in this study, poor DMF score) was separated into three components. E (explained part) is the gap in the average value of the explanatory variables, C shows the difference in the mean β (coefficient/unexplained part), and CE is the multiplication between the difference in mean of independent variables and their coefficients. If there are only two explanatory variables, the following formula can be used:

$$y^R - y^P = (\beta_0^R - \beta_0^P) + (\beta_1^R x_1^R - \beta_1^P x_1^P) + (\beta_2^R x_2^R - \beta_2^P x_2^P) = W_0 + W_1 + W_2$$

Where y is the poor DMF, W_0 shows the differences in the constant, W_1 is the difference between x_1 and β_1, and W_2 is the difference between x_2 and β_2. We used the non-linear BO decomposition method to decompose the factors explaining the gap in poor DMF score between the poorest and the wealthiest children.[15] All statistical analyses were performed in Stata software (version 14.1, Stata Corporation, College Station, TX, USA) and P-value less than 0.05 was used as the level of significance.

The Ethics Committee of the Deputy of Research of Kermanshah University of Medical Sciences reviewed and approved the study protocol (KUMS.REC.1397.436).

Results

Table 1 presents the descriptive statistics of the sample. The number of girls was 945 and the remaining 512 were boys. The mean age of the children was 13.15 years with a standard deviation (SD) of 0.99. The overall and age-adjusted prevalence of poor DMF index was estimated to be 36.92% [95% confidence interval (CI): 34.48-39.43] and 37.32% (95% CI: 34.64-40.08) for the entire sample, respectively. The crude prevalence of poor DMF score between boys and girls was different; it was 42.75% (95% CI: 39.62-45.93) for girls and 26.17% (95% CI: 22.53-30.16) for boys.

Table 2 reports the results of multivariate logistic regression analysis on the determinants of poor DMF index. The results showed an inverse association between prevalence of poor DMF score and wealth status.

Table 1. Descriptive characteristics and prevalence of poor decayed, missing, filled (DMF) index in Kermanshah City, Iran, 2018

Variable	mean ± SD	Prevalence of poor DMF (%)	
		Crude (95% CI)	Age-adjusted (95% CI)
Age (year)	13.15 ± 0.99	36.92 (34.48-39.43)	37.32 (34.64-40.08)
	n (%)		
Sex			
Male	512 (35.14)	26.17 (22.53-30.16)	23.71 (20.03-27.83)
Female	945 (64.86)	42.75 (39.62-45.93)	44.60 (41.15-48.09)
Mother education			
Uneducated or elementary	643 (44.13)	47.58 (43.74-51.46)	48.73 (44.55-52.92)
Academic degree	814 (55.87)	28.50 (25.49-31.70)	27.97 (24.71-31.49)
Father education			
Uneducated or elementary	501 (34.39)	48.30 (43.93-52.69)	49.13 (44.32-53.95)
Academic degree	956 (65.61)	30.96 (28.10-33.97)	31.02 (27.89-34.33)
Gender of household head			
Male	1390 (95.40)	36.76 (34.26-39.33)	37.14 (34.41-39.95)
Female	67 (4.60)	40.29 (29.02-52.69)	41.94 (27.54-57.85)
Wealth index of households			
Poorest	292 (20.04)	49.65 (43.91-55.39)	51.50 (44.64-58.29)
Poor	291 (19.97)	42.95 (37.35-48.74)	44.50 (38.01-51.18)
Middle	293 (20.11)	37.88 (32.47-43.60)	40.66 (34.29-47.35)
Rich	290 (19.90)	26.89 (22.08-32.32)	27.39 (22.26-33.20)
Richest	291 (19.97)	27.14 (22.09-32.20)	26.49 (21.62-32.00)
Regular brushing			
Yes	1229 (84.35)	35.39 (32.76-38.11)	35.92 (33.07-38.88)
No	228 (15.65)	45.17 (38.78-51.72)	45.82 (38.08-53.76)
Visiting dentist per six months			
Yes	384 (26.36)	35.41 (32.60-38.33)	36.50 (33.32-39.80)
No	1073 (73.64)	41.14 (36.30-46.16)	39.79 (34.80-45.01)

DMF: Decayed, missing, filled; CI: Confidence interval; SD: Standard deviation

For example, the likelihood of poor DMF score was 63% [odds ratio (OR): 0.37, 95% CI: 0.26-0.53] among the children belonging to the richest wealth quintile compared to the children from the lowest quintile. The prevalence of poor DMF score was more than two times (OR: 2.10, 95% CI: 0.29-0.43) higher among girls. There was also statistically significant association between low education of mother, irregular brushing, and no visit to dentists per six months with poor DMF score. There was no significant association between poor DMF score and age and gender of household head (P > 0.05).

Age-adjusted SII was 0.29 (95% CI: 0.19-0.40), while it was 0.23 (95% CI: 0.11-0.34) after adjusting for age and sex. The RII was 2.33 (95% CI: 1.72-3.16) when we adjusted for age and 1.93 (95% CI: 1.40-2.68) when we adjusted for age and sex. This suggests that the poor DFM score was more prevalent among poorer children.

Table 3 presents the results of the BO decomposition. The prevalence of poor DMF score for the poorest and the richest wealth groups was 49.65% (95% CI: 43.92-55.39) and 27.14% (95% CI: 22.09-32.20), respectively. The gap between the lowest and the highest wealth groups was 22.50% (95% CI: 22.09-32.20). About 97.3% of this gap between them was because of the differences in the distribution of independents variables (i.e., sex of child, mother's education, brushing, and visit to dentist) of the analysis. The difference in sex of child, mother's education, and brushing were found as the main determinants of gap in the prevalence of poor DMF score between the better-off and the worse-off groups. 39.7% of this difference between two groups was related to the differences in the coefficient of variables (response) or other factors that were not considered in our study. Additionally, -37.05% of the gap between two groups was attributed to the interactions (Table 3).

Table 2. Association between independent variables and poor decayed, missing, filled (DMF) index (logistic regression model)

Explanatory variables	OR			
	Crude (95% CI)	P	Adjusted (95% CI)	P
Age	1.10 (0.99-1.22)	0.071	1.07 (0.95-1.20)	0.214
Sex				
Male	1.00 (Reference)		1.00 (Reference)	
Female	2.10 (0.29-0.43)	0.001	1.66 (1.28-2.16)	0.001
Mother education				
Academic degree	1.00 (Reference)		1.00 (Reference)	
Uneducated or elementary	2.27 (1.83-2.83)	0.001	1.55 (1.17-2.04)	0.002
Father education				
Academic degree	1.00 (Reference)		1.00 (Reference)	
Uneducated or elementary	2.08 (1.66-2.60)	0.001	1.26 (0.95-1.67)	0.108
Gender of household head				
Male	1.00 (Reference)		1.00 (Reference)	
Female	1.16 (0.74-1.91)	0.558	1.10 (0.65-1.87)	0.700
Wealth index of households				
Poorest	1.00 (Reference)		1.00 (Reference)	
Poor	0.76 (0.55-1.05)	0.105	0.83 (0.59-1.18)	0.314
Middle	0.62 (0.44-0.85)	0.004	0.78 (0.55-1.12)	0.188
Rich	0.37 (0.26-0.52)	0.001	0.52 (0.35-0.76)	0.001
Richest	0.37 (0.26-0.53)	0.001	0.21 (0.41-0.96)	0.033
Regular brushing				
Yes	1.00 (Reference)		1.00 (Reference)	
No	1.50 (1.13-2.00)	0.005	1.54 (0.46-0.77)	0.006
Visiting dentist per six months				
Yes	1.00 (Reference)		1.00 (Reference)	
No	1.27 (0.48-0.62)	0.001	1.66 (1.28-2.16)	0.001

OR: Odds ratio; CI: Confidence interval

Figure 1 summarizes the share of each factor to the difference in prevalence of poor DMF score between the lowest and the highest SES groups due to distribution (explained part) and coefficient effects (unexplained part). The most important factors affecting the difference in poor DMF score were mother's education (18.23%), sex of children (6.12%), and visit to dentist (2.93%).
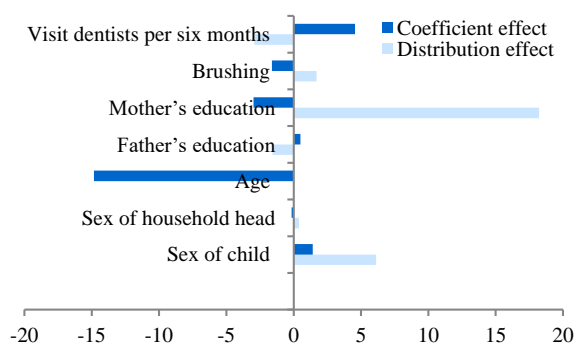
Figure 1. Contribution factors to differences in poor decayed, missing, filled (DMF) index in Kermanshah, Iran, 2018

Discussion

Although the occurrence of dental caries decreased in developed countries over the past 30 years, its prevalence remains high in children living in developing countries.[3] This study examined SES inequality in oral health among school children in Kermanshah. In our study, the overall prevalence of poor DMF index was 36.92% among school children in Kermanshah which was higher than the results found in other studies.[17,18] The logistic regression results indicated that being girl, low education of mother, irregular brushing, and no visit to dentist per six months were associated with poor DMF index. Our results suggested that poor DMF index was more prevalent among poorer children and the incidence of this indicator across SES groups was different. It was also different between boys and girls and the prevalence of poor DMF between girls (42.75%) was more than boys (26.17%).

Table 3. Blinder-Oaxaca (BO) decomposition of poor decayed, missing, filled (DMF) index in Kermanshah, Iran, 2018

Explanatory variables	Prediction (%)	95% CI	% of total gap*
Prevalence of poor DMF in the poorest group	49.65	43.92, 55.39	
Prevalence of poor DMF in the richest group	27.14	22.09, 32.20	
Total gap (difference)	22.51	14.86, 30.15	
1) due to distribution (explained)			
Sex of child (being girl)	6.12	0.36, 11.87	27.17
Sex of household head (being female)	0.39	-0.59, 1.37	1.75
Age	-0.02	-0.71, 0.67	-0.11
Father's education level (low)	-1.57	-16.70, 13.56	-6.97
Mother's education level (low)	18.23	6.33, 30.12	80.98
Brushing (irregular)	1.70	-0.17, -3.56	7.53
Visiting dentist per six months (no)	-2.93	-6.56, 0.69	-13.03
Subtotal gap (explained part)	21.91	5.69, 38.11	97.32
2) due to coefficient (unexplained)			
Sex of child (being girl)	1.41	-3.91, 6.73	6.27
Sex of household head (being female)	-0.16	-1.20, 0.88	-0.70
Age	-14.84	-109.35, 79.68	-65.92
Father's education level (low)	0.50	-1.05, 2.05	2.22
Mother's education level (low)	-2.99	-5.64, -0.34	-13.29
Brushing (irregular)	-1.62	-3.94, 0.69	-7.20
Visiting dentist per six months (no)	4.55	-4.63, 13.72	20.20
Constant	22.09	-72.23, 116.57	98.15
Subtotal gap (unexplained part)	8.94	-4.74, 22.63	39.73
3) due to interaction			
Sex of child (being girl)	2.01	-5.52, 9.55	8.94
Sex of household head (being female)	-0.14	-1.07, 0.80	-0.62
Age	0.14	-0.75, 1.02	0.60
Father's education level (low)	4.83	-9.16, 18.83	21.48
Mother's education level (low)	-16.41	-32.36, -0.45	-72.89
Brushing (irregular)	-1.17	-3.00, 0.66	-5.21
Visiting dentist per six months (no)	2.40	-2.45, 7.24	10.64
Subtotal gap	-8.34	-28.25, 11.57	-37.05

*Computed by dividing prediction for each determinant by the total gap (22.51)
DMF: Decayed, missing, filled; CI: Confidence interval

The inequality indices indicated that there was a pro-rich inequality in poor DMF index among the study samples. The RII showed that the prevalence of poor DMF index among the poorest children was 2.33 times higher than the richest children The SII revealed that the prevalence of poor DMF index among the poorest children was 0.29 higher than the wealthiest ones. In other words, the prevalence of poor DMF index for the poorest was more than the richest and the gap difference between the poorest and the richest wealth status groups was 22.50%. It could be explained by this fact that oral health care are very expensive and patients face high out-of-pocket payments to use these services. Negative statistical association between wealth status and DMF index are well established in studies conducted in developing and developed countries. For example, SES was the important factor affecting teeth caries and had an inverse relation with the DMF index in Iran.[19] Furthermore, Hosseinpoor et al.,[9] Pothidee et al. in Thailand,[20] Martins et al. in Brazil,[21] and Moradi et al. in Kurdistan Province, west of Iran,[8] found that there was a positive association between poor oral health and lower SES.

We found that poor DMF index was about two times more prevalent among girls than boys. This is contrasting to the finding of a previous study from Kurdistan, which reported poor DMF index more prevalent

among boys.[8] Nonetheless, similar studies found that boys had a healthier oral health.[22] Our results suggest a significant association between prevalence of poor DMF index and irregular brushing. Subjects who brushed their teeth regularly had better oral health status, while those who did not brush their teeth had poorer DMF index. The possible explanation is that children with a high caries rate could have lack of fluoride. These findings are similar to studies conducted by Shirzaiy and Mohageri.[23] The current study indicated that poor DMF index was associated with lower education level and the poor DMF index among school children who had a parent with academic degree was almost 2.27 times less than children who had a parent without academic degree. Hernandez-Palacios et al. found that association between poor oral health condition and lower education status was positive.[24] One reason for this is associated with the environment and community conditions where child was born and grown up.

Our analysis recommends that poor DMF index among school children who visited dentists in every six months was less than those who did not have regular visits to dentists. The reason behind this finding could be that children from poorer families could not visit dentist regularly and among this children, visits were mostly problem- or symptom-driven. On the other hand, children from richer families, visited dentist for preventive purposes. These findings follow the results reported by Mouradian et al.[25]

Our study had few limitations and any interpretation of the results should be based on

these limitations. Firstly, this was a cross-sectional study which did not allow to establish any causal relationship between prevalence of poor DMF index and its determinants. Secondly, the current study was undertaken in one city which could preclude the generalization of our results to Kermanshah Province and Iran. Further studies from different regions of Iran are required to make the results more robust and generalizable.

Conclusion

Monitoring socioeconomic inequality in DMF index is a major step for designing and implementing of effective interventions to reduce inequalities in oral health. The findings of this study suggested a high prevalence of poor DMF among school children from poorer households. Despite of having higher dental disease burden, these populations often have limited or no access to dental care. Inadequate access to essential health services may be one of the main drivers affecting social inequalities in oral health among school-going children. A holistic approach is needed to decrease these inequalities and oral health education for children should involve the poorest children and their parents.

Conflict of Interests

Authors have no conflict of interest.

Acknowledgments

References

1. Rowan-Legg A. Oral health care for children - a call for action. Paediatr Child Health 2013; 18(1): 37-50.
2. Tohidast Akrad Z, Beitollahi, Khajetorab AA. DMFT (Decayed, missing, filled, teeth) oral health index in sweets and cable industry workers. Iran J Public Health. 35(2):64-68.
3. Watt RG, Heilmann A, Listl S, Peres MA. London Charter on oral health inequalities. J Dent Res 2016; 95(3): 245-7.
4. Amirabadi F, Bazafshan E, Dehghan J, Zazouli M A. Evaluation of DMFT index in the 8-12 years old students of Zahedan City, Iran. Iran J Health Sci. 2015; 3(2): 52-60.
5. Ismail AF, McGrath CP, Yiu CK. Oral health of children with type 1 diabetes mellitus: A systematic review. Diabetes Res Clin Pract 2015; 108(3): 369-81.
6. Babaei Hatkehlouei M, Tari H, Goudarzian A, Hali H. Decayed, missing, and filled teeth (DMFT) index among first-

grade elementary students in Mazandaran Province, northern Iran. Int J Pediatr., 2017; 5(6): 5069-77.

7. Kizito A, Caitlin M, Wang Y, Kasangaki A, Macnab A. Oral health promotion in schools: Rationale and evaluation. Health Education 2014; 114(4): 293-303.

8. Moradi G, Moinafshar A, Adabi H, Sharafi M, Mostafavi F, Bolbanabad AM. Socioeconomic inequalities in the oral health of people aged 15-40 years in Kurdistan, Iran in 2015: A cross-sectional study. J Prev Med Public Health 2017; 50(5): 303-10.

9. Hosseinpoor AR, Itani L, Petersen PE. Socio-economic inequality in oral healthcare coverage: Results from the World Health Survey. J Dent Res 2012; 91(3): 275-81.

10. Petersen PE, Kjoller M, Christensen LB, Krustrup U. Changing dentate status of adults, use of dental health services, and achievement of national dental health goals in Denmark by the year 2000. J Public Health Dent 2004; 64(3): 127-35.

11. Vyas S, Kumaranayake L. Constructing socio-economic status indices: How to use principal components analysis. Health Policy Plan 2006; 21(6): 459-68.

12. Moreno-Betancur M, Latouche A, Menvielle G, Kunst AE, Rey G. Relative index of inequality and slope index of inequality: A structured regression framework for estimation. Epidemiology 2015; 26(4): 518-27.

13. Oaxaca R. Male-female wage differentials in urban labor markets. Int Econ Rev 1973; 14(3): 693-709.

14. Jann B. The Blinder-Oaxaca decomposition for linear regression models. Stata J 2008; 8(4): 453-79.

15. Sinning M, Hahn M, Bauer TK. The Blinder–Oaxaca decomposition for nonlinear regression models. Stata J 2008 8(4); 480–92.

16. O'Donnell O, van Doorslaer E, Wagstaff A, Lindelow M. Analyzing health equity using household survey data: A guide to techniques and their implementation. Washington, DC: World Bank; 2008.

17. Ashrafizadeh SS, Souri H, Ashrafizaadeh M. Assessment of oral hygiene status (DMFT) of twelve. Jundishapur J Microbiol 2002; (34): 60-6. [In Persian].

18. Kooshki A, Rivandi M, Behroozikhah MR, Akbarzadeh R. Relationship between DMF index and food intake in elementary students (Sabzevar, Iran). Journal of Biomedicine and Health 2016; 1(4): 1-4.

19. Kazerouni K, Mohammadi N, Ansari G, Kamali Z. The effects of socio-economic status on dental caries incidence in a group of primary school children, Tehran-2000. J Dent Sch 2005; 22(4): 51-9. [In Persian].

20. Pothidee T, Sringernyuang L, Tuongratanaphan S. Inequity in access to oral health service of primary students: A case study of a dental fund in a central region province. Kasetsart Journal of Social Sciences 2016; 37(3): 175-81.

21. Martins MT, Sardenberg F, Vale MP, Paiva SM, Pordeus IA. Dental caries and social factors: Impact on quality of life in Brazilian children. Braz Oral Res 2015; 29(1): S1806-83242015000100310.

22. Inglehart MR, Patel MH, Widmalm SE, Briskie DM. Self-reported temporomandibular joint disorder symptoms, oral health, and quality of life of children in kindergarten through grade 5: Do sex, race, and socioeconomic background matter? J Am Dent Assoc 2016; 147(2): 131-41.

23. Shirzaiy M, Mohageri G. Evaluation DMFT and CPTIN Indices and related personal behaviors in the 12-years-old students. Dent Clin Exp J 2018; 3(1): e65179.

24. Hernandez-Palacios RD, Ramirez-Amador V, Jarillo-Soto EC, Irigoyen-Camacho ME, Mendoza-Nunez VM. Relationship between gender, income and education and self-perceived oral health among elderly Mexicans. An exploratory study. Cien Saude Colet 2015; 20(4): 997-1004.

25. Mouradian WE, Wehr E, Crall JJ. Disparities in children's oral health and access to dental care. JAMA 2000; 284(20): 2625-31.