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Socioeconomic inequalities in oral health among adults in Tehran, Iran

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Objective: To identify the socioeconomic distribution of perceived oral health among adults in Tehran, Iran. ***Basic research design:*** A cross-sectional population study. ***Participants:*** A stratified random sample of 1,100 adults aged 18–84 years living in Tehran. ***Methods:*** Self-report data were obtained from the 2010 dental telephone interview survey. Oral health was evaluated using self-assessed non-replaced extracted teeth (NRET), and a three-item perceived dental health instrument. Socioeconomic status was measured by combining the variables of education and assets using principal component analysis. Inequalities in oral health were examined using prevalence ratios and concentration index. ***Results:*** The poorest quintile was 1.60 (95% confidence interval, CI, 1.30;1.98) times as likely to have any NRET compared with the richest quintile, indicating a disparity. Inequality was most pronounced in the 35–59 age group with prevalence ratio 2.01 (95%CI 1.26;3.05). The concentration index of NRET in adults in Tehran was -0.22 (95%CI -0.28;-0.16). No significant differences were found in perceived dental health between socioeconomic classes. ***Conclusions:*** Adults from lower socioeconomic classes experienced more disabilities due to missing their teeth, specifically in the middle-age group. Inequalities in perceived dental health were not apparent in the studied population.

Key words: *oral health, socioeconomic factors, Iran, NRET*

Introduction

Oral health is an area where socioeconomic disparity issues are evident in most developed nations, where those of a lower socioeconomic status (SES) experience ill health earlier and more severely compared with their better-off counterparts (Watt and Sheiham, 1999). Some theoretical explanations for this disparity are: a, the materialist explanation, which emphasises the role of external environmental factors beyond the individuals' control; b, cultural/behavioural explanations, which suggest that people from low socioeconomic backgrounds are more likely to engage in behaviours that are damaging to their health, in turn leading to higher levels of disease; c, psychosocial explanations, which argue that health inequalities result from differences in the experience of psychological stress between socioeconomic groups; and d, life course explanations, which claims that health inequalities result from the interaction of materialist, behavioural, and psychosocial factors over different stages of the life course, having a cumulative effect (Sisson, 2007).

Oral health, an important public health issue, suffers from existing and widening inequalities between and within countries (Petersen and Kwan, 2011). People from disadvantaged groups experience different opportunities, behaviours, beliefs and exposures to risk factors all of which are determined by their social position (Thomson, 2012). Social determinants are accepted as upstream factors in producing inequalities in oral health, and focusing on biomedical/behavioural factors could not tackle these inequalities (Watt, 2007).

Evidence of inequalities in adult oral health in developed countries has been widely documented; however, the relationship between socioeconomic factors and perceived oral health is less clear (Sanders and Spencer, 2004). Evidence on inequalities in both objective and perceived oral health measures from low- and middle-income countries is less available, and there is a need for more contextual research to inform understanding and policies in this field.

The Islamic Republic of Iran is a developing middle-income country in which primary oral health care services are the responsibility of the Ministry of Health and Medical Education. Basic dental care such as examinations, extractions, and scaling are available in public dental clinics and are subsidised by the government. However, the main provider of oral health care services is the private sector, where more than 80% of dentists work. The dentist-to-population ratio in all of Iran is 1:5,500, while in Tehran it is 1:1,800; 86% of private dentists work in single surgery practices (Bayat *et al.*, 2010).

Health inequalities have been recently documented in Iran including assessing the social determinants of health in Tehran using the Urban Health Equity Assessment and Response Tool (Urban HEART) survey piloted (Morasae *et al.*, 2012). Unfortunately, this large-scale survey did

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not include oral health measures, and the present study is the first attempt to explore oral health inequalities in adults in Iran. The little evidence on inequalities in oral health in Iran focuses mainly on children and adolescents. Children of the less educated parents had more dental caries and fewer restorations than those of the most educated (Saied-Moallemi *et al.,* 2006). Iranian adolescents of the highest social position reported having better oral health and no experience of dental pain (Ravaghi *et al.*, 2012).

The objective of this study was to describe the socioeconomic inequalities in perceived oral health among adults in Tehran, Iran.

Method

This study was a part of a cross-sectional telephone interview survey studying the socioeconomic inequalities in oral health and dental care utilisation in Tehran in 2010. The target population was dentate adults in Tehran city. The Tehran Telecommunication Company's (TTC's) almost 7,000,000 active telephone numbers provide over 95% of households with landline telephones. TTC's services are divided into 637 sub-regions. A sample of 1,068 was estimated for a 95% confidence interval, 50% dental visit proportion (Bayat *et al.,* 2010) with a margin of error no more than 0.03. However, a previous Tehran study (Bayat *et al.,* 2010) found only one-third of calls resulted in reaching a potential respondent. To overcome the uneven gender and age distribution of the respondents in the mentioned study, one out of eight Kish selection tables (Aday and Cornelius, 2006) were used to select a person from each household's list of eligible occupants. Taking these factors into account, about five telephone numbers are needed to reach one respondent, a total of over 5,000 numbers, 8 for each of the 637 sub-regions were generated in Excel 2007. After the first round of calls, 175 sub-regions' numbers had not resulted in a set of responses consequently, replacement telephone numbers were generated for those to ensure least one response each sub-region.

All phone calls were made by a single trained interviewer, who made the calls on either weekday mornings and evenings or weekend evenings, attempting each number up to three times. All calls were made between May 14 and December 14, 2010. When answered, a Kish selection table (Aday and Cornelius, 2006) was used to select a respondent. Each structured questionnaire interview lasted an average of 15 min.

Oral health was assessed by two outcome measures: first, respondents were asked about the number of non-replaced extracted teeth (NRET). Only teeth that were self-assessed as extracted as a result of decay, pain, or other dental disease and not replaced by fixed or removable prosthodontics were included in this study. Teeth lost for other reasons, such as injury or orthodontics, were not included. If wisdom teeth were removed because of tooth decay or gum disease, they were included in the count for lost teeth. Second, perceived dental health was measured by three questions, each scored using a four-point scale (0, never; 1, sometimes; 3, most of the time; 4, always), taken from the Rand Health Insurance Study (HIS) (Spolsky, 1983) with some changes. The three HIS dental health questions are directly related to major consequences of dental disease: pain, worry, and reduced social interaction. A pilot study showed that the question about "worry" does not make sense to the Iranian adult population. Because chewing is the important function of dentition and problems in eating or chewing may concern or worry people about their oral health, we decided to omit "worry" and to substitute it with "problems with chewing." A single measure for perceived dental health was then generated by adding up the scores from the three questions; the score of zero meaning no experience of any dental impact.

SES was measured using ten questions assessing: education (in years), house area per capita (m^2); house value based on location (mean price of m^2 of the region); house ownership (own/rent); and yes/no questions about having a car, computer, dishwasher, steam-cleaner (a device to clean surfaces), microwave, or internet access. The first component factor scores from principal component analysis (PCA) were then applied to classify the sample into five equal SES quintiles, the first quintile representing the poorest 20%.

The psychometric properties of the questionnaire were confirmed, including face and content validity, and test-retest reliability. Face and content validity, in terms of relevance, clarity and simplicity, were tested using ideas from ten experts in public health dentistry. To determine the reliability, a 35-sample test-retest study was performed within a two-week interval. The questions and interview procedures were pilot-tested on 100 randomly selected Tehran households and modifications were subsequently made to the procedures before starting data collection.

We used principal component analysis (PCA) to develop a SES measure, using STATA 11.1. Because the items included both binary and continuous variables, we used polychoric, polyserial, and Pearson's correlations in the PCA correlation matrix. Then, the SES classification to five quintiles, ranging from poorest to richest, was conducted by cluster analysis using the data driven approach.

Descriptive and bivariate analyses were used to explore the distribution of oral health measures among socio-demographic groups. The prevalence ratios (PRs) of having any NRET were used to study inequalities among SES quintiles.

Concentration index was the other measure used to assess socioeconomic inequalities in oral health. This index is defined according to a concentration curve (CC) which plots the cumulative percentage of a health variable against the cumulative percentage of population, ranked by poorest to richest. If everyone enjoyed the same level of health, regardless of SES, the CC would be a unity gradient line called the "line of equality." Usually though the outcome variable has higher (or lower) values among poorer people, then the CC would lie over (or under) the line of equality. The further the curve is away from the equality line, the more unequal is the distribution of the outcome variable. The concentration index, bound between -1 and +1, is defined as twice the area between the CC and the line of equality. Thus, a concentration index of zero indicates no inequality; when the CC is above (or under) the equality line, the concentration index takes a negative (or positive) value which means greater concentration of the outcome variable among poor (or rich) (Wagstaff *et al*, 1991).

The Iran Centre for Dental Research granted ethical approval for the present study. The participants were informed about the objectives of the study, and verbal consent was obtained for participation.

Results

Of the 5,271 telephone numbers, 3,771 telephone numbers were not reached (1,549 blocked lines, 1406 no answer, 572 were commercial lines, 184 were busy, 60 were fax lines). Of the 1,500 subjects who answered the phone calls, 400 refused to participate; leaving 1,100 adults (response rate 73% among those who answered) in the final sample. The respondents' mean age was 39.0 (SE 0.4) years and 50.8% were women. A one-sample t-test showed that the mean age of the sample did not differ significantly from the study population (mean difference=-0.11, 95%CI -0.9;0.8). Table 1 shows the distributions of respondents and study population by age group and gender.

Half the sample had high school education while 20% had under 8 years of education and 30% had an academic education. The mean NRET was 1.28 (SE 0.07), with 53.8% of the sample reporting none. No gender-related difference was found for NRET while older age groups had higher NRET (p<0.001). The mean NRET was 0.72 in the richest quintile and 2.30 in the poorest group. Some 70% of the sample had no dental pain while 80% and 97% had no problems in chewing and communication. The mean for perceived dental health score was 1.09 (SE 0.06), older groups getting higher (worse) scores (p=0.001), with 70% of people reporting no problems. Table 2 provides the distribution of NRET and perceived dental health among socio-demographic groups.

As shown in Table 3, in comparison with the richest quintile, the poorest quintile was 1.60 (95%CI 1.30;1.98) times as likely to have any NRET; when stratified by age, the difference was significant in only the middle age groups. In the 45–59 age group, poor people were two times as likely than rich people to have any NRET (PR=2.01, 95%CI 1.26;3.05).

Table 1. The distribution (%) of adult respondents versus the Tehran population by age and gender.

	Men		*Women*		*All*	
Age (years)	*Respondents %*	*Population %*	*Respondents %*	*Population %*	*Respondents %*	*Population %*
18-24	14	22	16	22	15	22
25-34	30	26	30	26	30	26
35-44	22	20	22	20	22	20
45-59	24	20	21	20	22	20
60+	10	12	11	12	11	12
n	539	4,078,514	556	3,899,159	1,095	7,977,673

Table 2. The distribution of non-replaced extracted teeth (NRET) and perceived dental health by socio-demographic groups

Variables	*n*	*%*	*NRET Mean (SE)*	*Any dental pain (%)*	*Any chewing problem (%)*	*Any communication problem (%)*	*Perceived dental health score mean (SE)*
Gender (n=1,095)			p=0.146 [a]	p=0.175[c]	p=0.371[c]	p=0.392[c]	p=0.479[a]
Male	539	49	1.32 (0.10)	27.6	20.0	2.6	1.06 (0.09)
Female	556	51	1.25 (0.09)	30.4	19.1	3.1	1.10 (0.09)
Age group (n=1,095)			**p<0.001**[b]	**p=0.003**[c]	**p=0.009**[c]	p=0.214[c]	**p=0.001**[b]
18-24	162	15	0.39 (0.06)	28.6	19.3	4.3	1.15 (0.17)
25-34	330	30	0.68 (0.06)	34.7	22.7	3.9	1.38 (0.13)
35-44	243	22	1.37 (0.12)	30.9	23.5	1.6	1.16 (0.13)
45-59	243	22	2.11 (0.19)	25.9	16.5	2.5	0.85 (0.12)
60+	117	11	2.35 (0.34)	16.2	9.4	0.9	0.46 (0.12)
Socioeconomic quintile (n=1,078)			**p<0.001**[b]	p=0.523[c]	p=0.581[c]	p=0.274[c]	p=0.457[b]
5th (richest)	214	19.8	0.72 (0.09)	27.0	20.0	3.3	1.03 (0.14)
4th	217	20.1	1.07 (0.15)	30.9	20.3	2.8	1.19 (0.15)
3rd	216	20.0	1.01 (0.12)	32.9	22.7	4.6	1.36 (0.16)
2nd	216	20.0	1.32 (0.13)	26.4	16.7	1.4	0.90 (0.13)
1st (poorest)	215	19.9	2.30 (0.23)	27.9	18.1	1.9	0.93 (0.12)

[a] Mann-Whitney test; [b] Kruskal-Wallis test; [c]Chi-Square test; **Bold**, Difference significant at the 5% level.

Table 3. Percentage of the sample having any non-replaced extracted teeth (NRET), its prevalence ratio and 95% confidence interval by age groups in socioeconomic quintiles

95% Confidence Intervals		*Prevalence Ratio of having any NRET*	*% having any NRET*	*Number of cases*	*Quintiles 1, poorest to 5, richest*	*Age group (years)*
Lower	*Upper*					
6.64	0.67	2.11	27.3	22	1	18-24
7.38	0.99	2.70	34.9	43	2	(n=159)
6.19	0.72	2.11	27.3	33	3	
7.37	0.91	2.58	33.3	30	4	
-	-	Reference	12.9	31	5	
2.17	0.90	1.40	53.5	43	1	25-34
1.90	0.82	1.25	47.8	67	2	(n=329)
1.23	0.48	0.77	29.3	82	3	
1.58	0.66	1.02	39.0	82	4	
-	-	Reference	38.2	55	5	
2.16	**1.04**	**1.46**	69.5	59	1	35-44
1.95	0.89	1.32	63.0	46	2	(n=243)
2.16	**1.04**	**1.50**	71.4	49	3	
1.17	0.40	0.68	32.6	43	4	
-	-	Reference	47.6	42	5	
3.05	**1.26**	**2.01**	68.4	57	1	45-59
3.04	**1.26**	**1.96**	66.7	45	2	(n=239)
3.05	**1.63**	**1.96**	66.7	42	3	
1.99	0.69	1.18	40.0	45	4	
-	-	Reference	34.0	50	5	
1.82	0.65	1.09	47.1	34	1	60+
1.98	0.52	1.01	43.7	16	2	(n=113)
2.09	0.28	0.77	33.3	9	3	
2.19	0.68	1.22	52.9	17	4	
-	-	Reference	43.2	37	5	
1.98	**1.29**	**1.60**	58.1	215	1	All
1.79	**1.15**	**1.43**	52.1	217	2	(n=1,079)
1.59	**1.01**	**1.26**	46.0	215	3	
1.35	0.83	1.05	38.2	217	4	
-	-	Reference	36.3	215	5	

Relationships significant at the 5% level are shown in **bold**.

The concentration index values were -0.22 (95%CI -0.28;-0.16) for NRET, and 0.002 (95%CI -0.004;0.007) for perceived dental health in Tehran. It indicated that the concentration of NRET was higher among people of lower SES, but for perceived dental health was equally distributed among SES groups. Figure 1 illustrates the CC of NRET in SES classes in Tehran adults; the CC for perceived dental health scores coincided with the equality line.

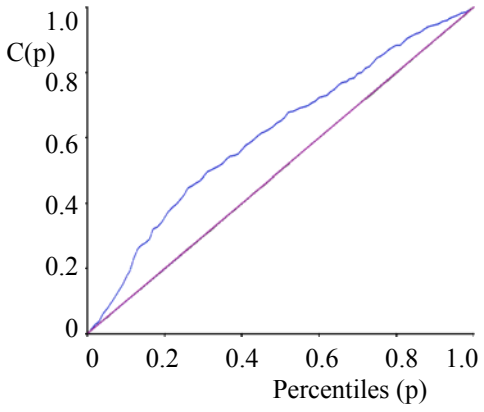

Figure 1. *The concentration curve of non-replaced extracted teeth among adults (n=1,095)*

Discussion

We found that socioeconomic inequalities exist in NRET among the study population of Tehran adults with a prevalence ratio of 1.60 and concentration index of -0.22. We decided to use the indicator of "non-replaced extracted teeth" because people with replaced teeth are at least partially rehabilitated by prosthesis. On the other hand, this index could demonstrate inequalities better than the more widely used index of "missing teeth." Poor people are more likely to have teeth extracted, and following extraction they are less likely to replace them. Similar unequally distributed tooth loss was reported in the UK, US with OR=1.6 and Australia with OR>2 (Marmot and Bell, 2011; Gilbert *et al.*, 2003; Sanders and Spencer, 2004). Having fewer than 20 teeth was associated with lower income in Norway with OR=2.48 and Thailand

with OR=1.45 (Haugejorden *et al.*, 2008; Yiengprugsawan *et al.*, 2011). Furthermore, evidence from Brazil and Spain (Celeste *et al.*, 2011; Pizarro *et al.*, 2006) showed that people from lower SES groups were 1.12 and 2.4 times as likely to experience edentulism, respectively, in comparison to higher SES groups. The variation among reported estimates from different studies may not to be real differences but artefacts of their different contexts, and measures and classifications of both SES and tooth loss. The present results demonstrated that poor people had either more extractions or less ability to replace missing teeth with fixed or removable prosthesis. There is sufficient availability of dentists in Tehran though there are often financial barriers to access. Because the dental care system is dominated by the private sector, the high costs of dental services and the composition of benefit packages covered by public insurance in Iran may be factors that lead poorer people not to seek fillings or root canal therapy, to extract affected teeth, and not to replace them. It was reported that uninsured people in Tehran, who are more likely to be poor, had tooth extractions almost twice as frequently as insured people (Bayat *et al.*, 2011).

NRET did not significantly differ by gender. Evidence also suggests that gender is neither associated with nor a causal factor for determining reported tooth loss or for perceived oral health (Locker and Slade, 1994; Sanders and Spencer, 2004).

Similar to the results of an Australian survey (Sanders and Spencer, 2004), socioeconomic inequalities in tooth loss were more apparent in middle-aged participants than in younger or older adults. This pattern of inequality is also observed in general health. Inequalities steadily accumulate across the young adult years, eventually peaking among middle-aged adults. Socially disadvantaged people experience ill health earlier and more severely than the better-off. Increasingly in older age, more adults begin experiencing similar ill health, narrowing the social inequality across the last decade or two of life (Spencer, 2004).

We did not find any significant inequalities in perceived dental health in the study population, which is mostly consistent with the Australian study, which found it in only the under 44 year-old group (Sanders and Spencer, 2004). Unlike our study results, an OR (lowest vs highest income quartiles) of 2.22 was reported for poor perceived oral health in the US and a concentration index of -0.21 in Thailand (Sabbah *et al.*, 2011; Somkotra, 2011). This disparity may be because of the differences in SES and oral health measures or the cultural contexts of the studies. Global self-rated oral health and the oral health impact profile, which were used in these studies, may be more sensitive to socioeconomic differences. Additionally, it has been mentioned elsewhere that inequalities in tooth loss are usually more noticeable and better follow the social spectrum when compared with perceived oral health (Spencer, 2004). This may be because perceived oral health indicators depend on people's different expressions, expectations, and cognitions about the standards of oral health (Locker and Slade, 1994). Thus, for people with the same oral health status, poorer people may have fewer complaints about their oral health problems, and they may be more satisfied with their oral health than rich people.

The results of the present study may not be generalisable from Tehran City to all Iran as though the former has more than 11% of the population of Iran, they have the highest gross income and expenditure in the country (ESD, 2011). The SES across Iran has much greater heterogeneity and the extent of oral health inequalities are greater outside Tehran.

In comparison with previous telephone surveys in Tehran (Bayat *et al.*, 2010), our chosen sampling methods allowed better matching to the Tehran population in terms of gender and age. The other advantage of the present study was that we used PCA to create a well-designed SES measure for Tehran adults. Because of the low expected response rates and questionable reliability of self-reported income level in the study population (Bayat *et al.*, 2011), we used a new mixed SES measure for Iranian adults (Ghorbani *et al.*, 2012).

Nevertheless, our study has its own limitations, including the cross-sectional design, exclusion of people without landline numbers, use of self-assessment to measure tooth loss, and exclusion of edentulous people. However, these limitations might be considered somewhat ameliorated by the high population coverage of landline phones in Tehran (Bayat *et al.*, 2010), the accepted validity of the self-assessed tooth loss instrument via telephone interview (Pitiphat *et al.*, 2002), and low rate of edentulousness in the studied population (Hessari *et al.*, 2008). In the case of the impacts of oral diseases, another limitation was our inability to ask detailed questions because of time considerations in the telephone interviews. This study provides preliminary evidence of the socioeconomic distribution of oral health among adults in Iran. We concluded that extracted teeth were disproportionally concentrated in poor adults, and this inequality was more evident in middle-aged people. In contrast, oral disease impacts were equally distributed in Tehran adults from different socioeconomic classes. There are some implications of the findings: future oral health promoting programs should not only target the overall improvement of the population's oral health, but also it should consider its possible effects on the existing inequalities in oral health. It is suggested that appropriate socioeconomic measures should be considered in designing large-scale oral health surveys with a view to identifying the social determinants of oral health, especially for the Iranian population.

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