Caries Experience of Urban and Rural Children in Saudi Arabia

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Abstract

Objective: *Caries experience and restorative treatment needs often are reported to be higher in urban than rural areas in developing countries. The purpose of this study was to compare caries experience in 12- and 13-year-old children in urban and rural areas of Saudi Arabia, a young, oil-rich, developing country.* ***Methods:*** *A random sample of 1,873 schoolchildren aged 12–13 years from urban and adjoining rural areas of 10 administrative regions in the Kingdom of Saudi Arabia were examined for dental caries. Questionnaires also were administered to elicit information on the frequency of snacking as well as consumption of sweets and soft drinks.* ***Results:*** *No statistically significant differences were found between urban and rural children in caries experience in permanent teeth (mean DMFT=2.69 in urban areas; 2.65 in rural areas), frequency of snacking, or frequency of consumption of sweets and soft drinks. The percentage of DMFT found to be D was equally high (>89%) in both urban and rural areas, indicating a high level of restorative treatment need.* ***Conclusion:*** *In Saudi Arabia, an economically prosperous developing country, exposure to cariogenic diet in urban and rural areas does not differ. Also, a difference in caries experience in urban and rural areas often reported for developing countries does not apply to Saudi Arabia. [J Public Health Dent 1999;59(1):60-64]*

Key Words: dental caries, urban and rural children, food habits, Saudi Arabia.

The distribution of dental caries is influenced by numerous factors. In some developing countries, the disease is more prevalent in children of higher socioeconomic status, usually those residing in urban areas (1). For example, caries experience was found to be higher in urban than rural populations in Nicaragua (2), Mexico (3), Indonesia (4), and Ghana (5). In contrast, caries experience recently was reported to be higher in rural than urban children in France (6), a Western industrialized country.

Saudi Arabia is a relatively young, oil-rich, developing country situated between the Red Sea and the Arabian Gulf. Recently, a Western type of diet rich in refined carbohydrates has become commonplace in the country (7). Because Saudi children in urban areas generally belong to a higher social class than those living in rural areas (8), a study of caries distribution in the children in Saudi cities and villages is of interest. The purpose of this study is to compare the caries experience of 12- to 13-year-old children in urban and rural areas of Saudi Arabia. This study was part of a nationwide oral health survey of the kingdom, based on methods used in the Second International Collaborative Study (ICS-II) of oral health systems (9).

Methods

Study Population and Sample Size. Ten out of the 14 administrative regions in the kingdom where at least one municipality had a population of not less than 100,000 were selected. Based on the 1974 census figures and a 3 percent annual growth rate (10), the total population of 12- and 13-year-old children in the selected administrative regions was estimated to be 658,986 at the time of the study in 1994. Three sparsely populated northern administrative regions (Al-Qurriyat, Al-Jouf, and Northern Frontier) with no urban areas were excluded, as was the Central Region covered in ICS-I (11).

We calculated a sample size requirement of 1,604 based on an estimated 60 percent prevalence of dental caries among 12- and 13-year-old children (7,11). This size sample was expected to produce a prevalence of dental caries within 2 percent of the value reported in the literature at a 95 percent confidence level and with a statistical power of 90 percent (12).

Sampling Technique. The children examined in this study were selected by a two-stage stratified cluster sampling technique. The stages were the municipalities and schools, while stratification was based on socioeconomic status and classrooms formed the sample clusters. Each of the 10 selected municipalities, together with an adjoining village about 50 km away, was allocated a sample size proportional to its population of 12- and 13-year-old children. Socioeconomic status was determined by housing quality, which has been classified as good, fair, and poor by the Ministry of Municipality and Rural Affairs, Saudi Arabia (8). According to this classification, "good" houses are located in areas with wide roads and low population density. The houses in these areas are big, centrally air-conditioned, and inhabited by small families, with more than one room per inhabitant. Houses classified as "fair" are located in areas with narrow, but motorable, roads and high population density. Most of these houses are blocks of flats with one or two persons per room. The "poor" houses, built with mud walls and having more than five persons per room, are located in areas with very high population density.

Thirty primary and 30 intermediate schools were selected randomly from a total of 6,231 schools in the 10 administrative regions. Primary and inter-

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mediate schools were included in the sample because 12- and 13-year-old children in Saudi Arabia are either in the upper grades of primary schools or lower grades of intermediate schools. All children of the selected ages attending the 60 schools were included in the sample. No incentives for participation were offered the students.

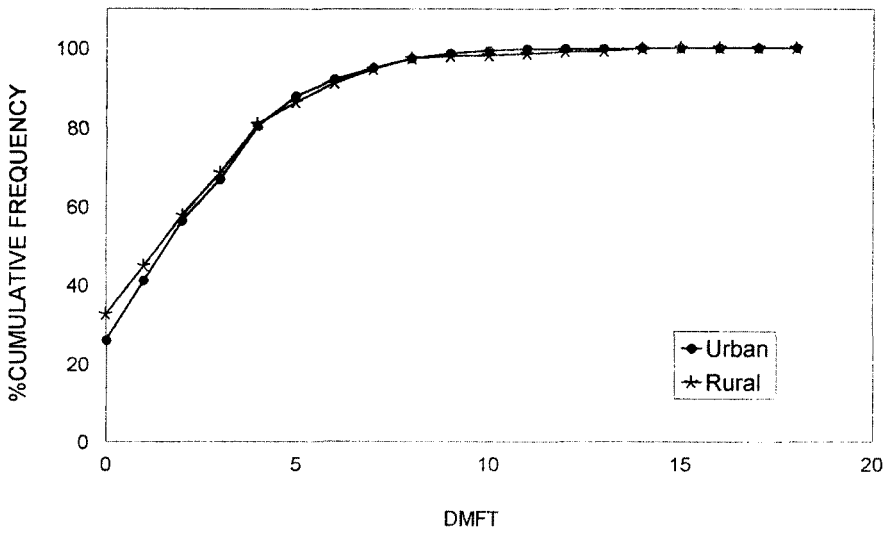
Clinical Examination and Child Questionnaire. After obtaining informed consent from the school authorities, the subjects, seated on a chair, were examined for dental caries under natural lighting conditions following the WHO criteria (13). DMFT scores were calculated for the entire population, from which the restorative index (D/DMFT%) was calculated.

The children also completed a questionnaire that inquired about their consumption of a sugar-containing diet as well as frequency of snacking, based on a 24-hour recall. Sugar-containing foods listed in the questionnaire included cereals, chocolates, cakes, doughnuts, and soda; consumption of any of these food items in between the three main daily meals was regarded as snacking (7).

Examiner Reliability. Two dentists from each of the 10 administrative regions in the kingdom who were experienced in epidemiologic surveys examined for dental caries experience. They were calibrated in a preliminary study against a reference investigator who visited each of the administrative regions. The field examiners in each region and the investigator performed duplicate examinations on 20 subjects. Cohen's kappa statistic was used to determine examiner agreement in the diagnosis of carious teeth in each region (14). During actual field work for the study, duplicate examinations were completed by each examiner on about 10 percent of their subjects for determination of intraexaminer agreement, also quantified by the kappa statistic.

Statistical Analysis. Friedman's nonparametric analysis of variance (ANOVA), Wilcoxon rank-sum test, and the chi-square test were used to assess the statistical significance of differences in caries experience, as well as dietary habits between children living in urban and rural areas (15). Because we were not trying to provide national estimates for caries experience, but rather the association between population density and caries experience, we did not consider the complex sample design in the analysis. The Statistical Analysis System (SAS) software was used to analyze all data (16).

FIGURE 1
Cumulative Percent Frequency Distribution of DMFT in 12- and 13-year-olds in Urban and Rural Areas of Saudi Arabia



Results

Study Sample. The sample was composed of approximately equal numbers of boys and girls; about 74 percent were from urban areas. Because all children in the selected classrooms were included in the sample, the number of children examined (n=1,873) was greater than the estimated sample size of 1,604. None of the children refused examination. The percentages of children from urban areas with good, fair, and poor housing quality were 61, 21, and 18, respectively. All sampled children living in rural areas had poor housing quality.

Caries Experience. During calibration exercises, examiner agreement in the diagnosis of carious teeth as measured by the kappa statistic varied between 0.76 and 0.99 for the 10 administrative regions. Kappa statistics for replicate examinations by each examiner during the survey itself varied between 0.68 and 0.99.

About 33 percent of children from rural areas were caries free. In contrast, only 26 percent of those from urban areas were caries free (P<.01) (Figure 1).

No statistically significant differences were found between overall mean DMFT scores of children in urban and rural areas, or between boys and girls (ANOVA, P>.05) (Table 1). Mean DMFT scores of children residing in houses of poor quality in urban and rural areas did not differ (ANOVA, P>0.05). Furthermore, no significant differences were found between the mean DMFT of rural children, all of whom were living in houses of poor quality, and the mean DMFT for all urban children residing in houses of any quality type (ANOVA, P>.05). Among girls, mean DMFT was lower in children residing in houses of poor quality than those residing in houses of either fair or good quality; however, the finding was opposite for boys (ANOVA, P<.05). Caries experience was greater in boys from areas of poor housing quality than those from other areas.

No significant difference was found between urban and rural areas in the percentage of DMFT that was D (Wilcoxon rank-sum test, P>.05) (Table 1).

Snacking. Complete data on snacking habits as well as consumption of sweets and soft drinks were available for 1,693 (90% of 1,873 examined) and 1,653 (88% of 1,873 examined) children, respectively (Table 2). Urban boys consumed snacks more frequently than rural boys (chi-square test, P<.001). Overall, however, no significant difference (chi-square test, P>.05) in the frequency of snacking was found between urban and rural children. Urban boys consumed significantly more sweets and soft drinks

TABLE 1
Mean DMFT and Restorative Index for 12- and 13-year-old Children, by Type of Residential Area and Sex, Saudi Arabia

		Urban				Rural	
		Good	Fair	Poor	Combined	Poor	Total
Boys	*N*	437	119	137	693	244	937
	DMFT (SD)	2.67 (2.56)	2.13 (2.04)	2.71 (2.60)	2.58 (2.48)	2.80 (2.70)	2.69 (2.54)
Girls	*N*	408	173	112	693	243	936
	DMFT (SD)	3.27 (2.87)	2.19 (2.43)	2.09 (2.17)	2.81 (2.65)	2.27 (2.76)	2.67 (2.69)
Combined	*N*	845	292	249	1,386	487	1,873
	D	2.63	1.97	2.18	2.41	2.31	2.38
	M	0.15	0.07	0.11	0.13	0.11	0.12
	F	0.17	0.12	0.13	0.15	0.12	0.14
	DMFT (SD)	2.96 (2.70)	2.16 (2.22)	2.43 (2.41)	2.69 (2.57)	2.59 (2.74)	2.65 (2.62)
	(D/DMFT)%	88.85	91.20	89.71	89.59	90.94	89.81

Friedman's nonparametric ANOVA for DMFT: housing quality by sex: $P<.05$. All other comparisons not significant ($P>.05$).
Wilcoxon rank-sum test for D/DMFT%: comparisons not significant ($P>.05$).

TABLE 2
Frequency Distribution for Consumption of Snacks, Sweets, and Soft Drinks as well as Oral Hygiene Practices for 12- and 13-year-old Children, by Type of Residential Area and Sex, Saudi Arabia

		Urban		Rural	
		# Boys (%)	# Girls (%)	# Boys (%)	# Girls (%)
Snacks	Thrice or more a day	107 (15.81)	95 (14.66)	49 (21.03)	17 (12.59)
	Twice a day	136 (20.09)	76 (11.73)	57 (24.46)	18 (13.33)
	Once a day	134 (19.79)	115 (17.75)	25 (10.73)	33 (24.44)
	Occasionally, but not every day	211 (31.17)	212 (32.72)	77 (33.05)	43 (31.85)
	Rarely or never eat between meals	89 (13.5)	150 (23.15)	25 (10.73)	24 (17.78)
Sweets	Percent yes	304 (44.71)	282 (43.25)	120 (50.85)	49 (36.30)
Soft drinks	Percent yes	564 (82.94)	419 (64.26)	180 (76.27)	92 (68.15)
Oral hygiene method	Toothbrush/toothpaste	255 (46.03)	413 (70.0)	119 (52.65)	88 (66.67)
	Miswak	29 (5.23)	23 (3.9)	6 (2.65)	5 (3.79)
	Both	201 (36.28)	103 (17.46)	72 (31.86)	25 (18.96)
	None	69 (12.45)	51 (8.64)	29 (12.83)	14 (10.61)

Chi-square test: snacks (urban vs rural boys: df=3, $P<.001$). Sweets and soft drinks combined (urban vs rural boys df=1, $P<.05$). Other comparisons not significant ($P>.05$).

than rural boys (chi-square test, $P<.05$); but again, there was no statistically significant difference ($P>.05$) between the consumption of these items among urban and rural children overall (Table 2).

About 85 percent of all children used toothpaste for their oral hygiene, either with a toothbrush alone or in combination with a chewing stick.

Discussion

Our estimate for the number of 12–13-year-old children in the kingdom was based on the 1974 census assuming a 3 percent growth rate (10). At the time of our study in 1994, no other census figures were available for Saudi Arabia. Even though a differential growth rate might have occurred among the population subgroups defined according to the stratification variables, no published information is available. The sample size of 1,873, which is larger than the estimated size of 1,604, might have affected the variance estimates, but increased the power of statistical tests.

The caries experience in developing countries is influenced by socioeconomic factors (1). Educational attainment often is used as one of the indicators of socioeconomic status in some of these countries; however, it might not be valid for the Saudi society. To ensure that children of various socioeconomic groups were adequately represented in the sample, housing quality of the children's residential area was used as the measure of socioeconomic status. This approach has been used by other dental investigators in Saudi Arabia (11).

The mean DMFT scores of 2.59 and 2.69 obtained in our study for rural and urban children, respectively, are higher than the 1.67 to 2.43 recorded in a study of urban 12–13-year-old chil-

dren in Riyadh (17). In a study by Al-Khateeb et al. (18), mean DMFT scores varied from 1.5 to 1.8 in 12-year-old students attending privately funded, high socioeconomic status schools in the Mecca region, lower than the estimate of 2.5 obtained in our study. In government-funded schools attended by children of lower socioeconomic status, however, caries experience in their study was higher, with the mean DMFT score ranging from 1.8 to 5.1.

In the present study, caries experience was greater in urban boys from areas of poor housing quality than those from areas with good or fair quality houses where most of the educated, middle-class reside (Table 1). This finding agrees with the report by Al-Khateeb et al. (18) in which they indicated that caries experience was greatest in Saudi Arabian children of lower socioeconomic status. Our findings also suggests the suitability of housing quality as an indicator of social class in the kingdom; however, this conclusion needs to be studied further, particularly because the association between housing quality and caries experience in girls is opposite that in boys.

Caries experience among 12- to 13-year-old children observed in the present study is higher than that in some European countries (19), but is about the same as that recorded in some parts of the United States with optimal water fluoridation (20). For example, the mean DMFT in 12-year-old children in Sweden (19) is 1.6; in 12-year-old US children with life-long exposure to fluoridated water (20), it is 2.4. In Saudi Arabia, the fluoride level in drinking water varies widely, from 0.08 ppm to 3.15 ppm (21). A higher prevalence of dental fluorosis in rural areas compared to urban areas recently was reported in the kingdom (22), suggesting that some rural Saudi populations obtain their drinking water from wells with high fluoride content (23). Nevertheless, toothpaste imported into Saudi Arabia is fluoridated and it is available in both urban and rural areas. Approximately 85 percent of the study sample used fluoridated toothpaste. Thus, the extent to which fluoride exposure influences the caries distribution in urban and rural children is not clear and needs to be studied further.

The high proportion of unrestored carious teeth in urban and rural areas in this study is cause for concern. A similar observation has been reported in Riyadh (7). The restorative treatment need in the United States, measured by D/DMFT%, varies between 10 and 24 percent (24); in Saudi Arabia, between 89.3 and 91.0 percent (Table 1). Approximately half the dentists in Saudi Arabia work for government dental clinics and health centers, with the remainder working in private clinics in urban areas (25). Most of these clinics emphasize curative services; nevertheless, the proportion of unrestored teeth remains high. Clearly, these is a need to strengthen preventive and therapeutic dental services for schoolchildren in both urban and rural regions of the kingdom.

Contrary to our expectation, we found no overall difference in mean DMFT scores between urban and rural children Furthermore, we found no overall statistically significant difference between urban and rural children in their frequency of snacking or consumption of sweets and soft drinks. This finding suggests that sugar is equally available in urban and rural areas of Saudi Arabia. In South America (2), Indonesia (4), and Africa (26, 27), where caries experience is lower in rural than in urban areas, the traditional diet usually contains little sugar and the rural populations are hardly exposed to sweets and soft drinks. In Saudi Arabia, an economically prosperous developing country, exposure to cariogenic diet in urban and rural areas does not seem to differ; hence, the difference in caries experience often reported for urban and rural areas in developing countries does not apply to the population of Saudi Arabian children studied.

Acknowledgments

I am grateful to the Minister of Health for giving me permission to carry out this work throughout the Kingdom of Saudi Arabia. I also thank the various heads of dental services in the country for their cooperation. Special acknowledgment is due to Professor E. S. Akpata for his valuable scientific recommendations during the course of this study, as well as the cooperation of the Oral Health Survey team. This work was supported by King Abdulaziz City for Science and Technology, grant #AR-11-86.

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