Community Dental Health (2009) **26,** 250–256
Received 26 November 2007; Accepted 31 August 2008

doi:10.1922/CDH_2397Yee07

The periodontal health of Nepalese schoolchildren

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Objectives: To report on the periodontal status of schoolchildren in urban and rural Nepal and to identify possible risk indicators of poor periodontal health. ***Design:*** Cross-sectional 'pathfinder' survey using the stratified cluster sampling technique included seven urban and nine rural sites representing the three geographic divisions and five political regions of Nepal. Second stage sampling involved the random selection of 25 schools (18 government and seven private). ***Subjects:*** Final study population consisted of three age groups: 5-6-years (n = 1025), 12-13-years (n = 1037) and 15-16-years (n = 1053). ***Outcome measures:*** Periodontal data was collected using CPI based on WHO methodology and criteria by trained examiners. A structured questionnaire was administered to collect information on oral health behavior and socio-economic status. ***Results:*** A gradual decline in the mean number of healthy sextants was noted with an increase in age among the schoolchildren. Males and females within a specific school and area showed no statistical significant difference when assessed for differences in score 0 (healthy periodontium) among all age groups except for 15-16-year-olds studying in government-urban schools. Multivariate logistic regression analyses showed that children 5 to 6 years of age studying in government urban (Adjusted Odds Ratio = 1.5, 95% Confidence Interval = 1.1-2.1) and government rural schools (Adj OR = 2.8, 95% CI 1.9-4.1) were at higher risk of having periodontal conditions (CPI scores > 0) when compared to those in private urban schools. The probability of poorer periodontal status increased for 12 to 13 (Adjusted OR = 1.9, 95% CI 1.3-2.9) and 15 to 16-year-old children (Adjusted OR = 1.7, 95% CI 1.1-2.5) who studied in government rural schools. ***Conclusions:*** A steady increase in periodontal conditions was observed with increasing age. The main risk indicator for unhealthy periodontal status at 5-6 years was studying and residing in government rural and urban schools; while the indicator of unhealthy periodontal status for children 12 to 13 and 15 to 16 years of age was studying in rural government schools.

Key words: CPI, Nepal, periodontal health.

Introduction

According to the World Oral Health Report 2003, dental caries and periodontal diseases are considered to be the most important global oral health burdens (Petersen, 2003). On a global scale, gingivitis amongst children and the initial stages of periodontal disease amongst young adults are widely prevalent, while only 5-15% of most populations have severe periodontal disease resulting in tooth loss. In the South-East Asian country of Nepal the collection of national information on the periodontal health of children and adolescents had never been undertaken other than a few localised cross-sectional studies (Burgard, 1984; Tewari, 1985). Analysis of the periodontal data indicated that 68-97% of the subjects aged 12-19-years had calculus (van Palenstein Helderman *et al*., 1998).

One of the first activities of the recently established Oral Health Focal Point in the Ministry of Health was to conduct a national oral health 'pathfinder' survey to collect baseline information on the oral health of the population (Yee and Mishra, 2004). The aim of this study is to describe the periodontal health amongst 5-6, 12-13 and 15-16-year-old school children in Nepal using the survey data collected between April and August 2004. Efforts to identify possible risk indicators associated with periodontal conditions (Community Periodontal Index (CPI) scores >0) are also elucidated.

Methods

Nepal is a small country of 147,181 square kilometres located between China to the north and India to the South with three distinctive geographical regions: the Terai (plains) to the south, the hills (Upper Hills and Middle Hills) and the mountains bordering China. The country is divided politically into 5 developmental regions (Far Western. Mid Western, Western, Central and Eastern) with 14 zones, 75 districts and 58 municipalities. It is the world's 13th poorest country with a per capita Gross National Income (GNI) of US$240 in 2003 (World Bank Group, 2006).

Based on the latest census conducted in 2001, Nepal has a population of 23,151,423 people (male: female ratio of 1:1) of which 49% are under the age of 18 years and 12% are under the age of five years (His Majesty's Government of Nepal, 2002). Eighty percent of the people live in rural areas with limited access to health and educational facilities. The remaining population live in the 58 municipalities with populations over 9,000. Five percent of the population (1.5 million) live in the urban sprawl of the Kathmandu Valley; 1.7 million live in the

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mountains; 10.2 million occupy the hills and 11.2 million people reside in the Terai.

The 2004 'pathfinder' survey used the stratified cluster sampling technique. Due to the poor security situation in Nepal, difficult geography and limited resources, urban and rural centres were conveniently chosen in the first stage. At the second stage schools were selected by simple random sampling of schools from the Ministry of Education registry in each site. A total of 25 schools (18 government and seven private) from nine rural and seven urban sites from the five development regions and 3 physiographic divisions were chosen. Rural villages were located away from the main highway. In rural locations a single government school was selected while in urban locations a government and a private school were selected. Rural villages rarely have private schools. All schoolchildren of the specified age groups who were in attendance at the time of school visit were examined. Due to low attendance at government schools at two rural sites, schoolchildren from two additional government schools were enrolled into the study.

The clinical examinations were conducted in sunlight or with the aid of LED (Light Emitting Diode) headlamps using mouth mirrors and WHO recommended CPI periodontal probes (World Health Organisation, 1997) on subjects who were reclined on chairs or benches. Instruments were appropriately sterilised. A structured questionnaire was administered to collect information on oral health behaviour and socio-economic status from all age groups except for 5-6-year-olds. The questionnaire was pilot tested on 25-30 subjects of each age group and then adjusted prior to usage in the main survey. Children under the age of 15 years were not examined for periodontal pockets.

Five examiners (dentists) and seven interviewer/recorders were trained for six days on interviewing technique, examination procedures, and interpretation, understanding and application of the WHO criteria and codes for dental caries and CPI (World Health Organisation, 1997).

Consent for the survey was obtained from the Nepal Health Research Council, District Education Offices, District Health Offices, head teachers and from the subjects.

The data were analysed using the Statistical Package Social Sciences version 14.0 (SPSS Inc, Chicago IL). The Mann-Whitney U tests (univariate) were performed to measure mean differences in healthy periodontal status (no disease) between groups of children. An entry method of logistic regression model was constructed with periodontal condition as the dependent variable (0 = CPI = 0 and 1 = CPI > 0) in all age groups. All possible two-way interactions were checked for in the multiple regression analysis. In the final analysis, in order to check for confounding, all variables were included irrespective of statistical significance. The 95% confidence intervals (CI) and odds ratios (ORs) were estimated to determine the significance of the predictor variables. The level of statistical significance was set at $p<0.05$.

Results

The study population comprised of three age groups, 5-6, 12-13 and 15-16-year-olds. The total number of school children in each group consisted of 1025, 1037 and 1053, respectively. Table 1 illustrates the age and gender distribution.

A gradual decline in the mean number of healthy sextants was noted with an increase in age among the schoolchildren, according to the school type and area (Table 2). A statistically significant higher mean number of healthy periodontal sextants were observed among children in private-urban schools compared to those in government-urban schools in all age groups except 15-16-year-olds (Table 2). The analysis also depicted significant differences among children with no periodontal conditions between government-urban and government-rural schools, as well as, private-urban and government-rural schools in all age groups.

Males and females within a specific school and area showed no statistical significant difference when assessed for differences in score 0 among all age groups except in 15-16-year-olds studying in government-urban schools ($p = 0.045$).

Table 3 depicts the percentage of children among variables of socio-demographic, oral health behaviours and caries experience (dmft/DMFT = 0 and dmft/DMFT > 0) according to individuals with periodontal conditions

Table 1. Distribution of 5-6, 12-13 and 15-16-year-old schoolchildren according to age and gender in Nepal.

Age	*Total Number (%)*	*Males Number (%)*	*Females Number (%)*
5 years	619 (60)	315 (51)	304 (49)
6 years	406 (40)	226 (56)	180 (44)
Total	1025 (100)	541 (54)	484 (47)
12 years	390 (38)	191 (49)	199 (51)
13 years	647 (62)	312 (48)	335 (52)
Total	1037 (100)	503 (49)	534 (52)
15 years	1005 (95)	531 (53)	474 (47)
16 years	48 (5)	31 (65)	17 (35)
Total	1053 (100)	562 (59)	491 (41)

Table 2. Percentage of 5-6, 12-13-and-15-16-year-olds with highest CPI score and mean number of sextants scored in relation to school type and area.

School type, area and age	*n (%)*	*Percentage of subjects with a highest score of*					*Mean (SD) number of sextants with scores*							
		0	1	2	3	4	0	1/2	2	1/2/3/4	2/3/4	3/4	4	X
		No disease	Bleeding on probing	Calculus	Pd 4-5mm	Pd 6+ mm	No disease	Bleediing & calculus	Calculus	Bleeding or higher	Calculus or higher	Pd 4+mm	Pd 6+mm	Excluded less than 2 teeth
5-6 year-olds														
Private - Urban	340 (33)	44	4	52			4.9 (1.2)* ¬	1.0 (1.2)	1.0 (1.1)					
Government - Urban	277 (27)	35	4	61			4.6 (1.5)* ^	1.4 (1.5)	1.3 (1.4)					
Government - Rural	408 (40)	21	16	62			3.5 (1.9)^ ¬	2.5 (1.9)	1.7 (1.8)					
Total	1025 (100)	33	8	58			4.3 (1.7)	1.6 (1.7)	1.3 (1.5)					
12-13 year olds														
Private - Urban	315 (30)	34	10	56			4.2 (1.8)* ¬	1.8 (1.8)	1.4 (1.6)					
Government - Urban	312 (30)	30	9	61			3.7 (1.9)* ^	2.3 (1.9)	1.8 (1.9)					
Government - Rural	410 (40)	18	13	69			3.1 (1.9)^ ¬	2.9 (1.9)	2.1 (1.9)					
Total	1037 (100)	27	11	62			3.6 (1.9)	2.3 (1.9)	1.8 (1.9)					
15-16-year-olds														
Private - Urban	320 (30.4)	29.1	8.1	60.3	2.5	0.0	3.8 (1.9)^			2.2 (1.9)	1.8 (1.9)	0.1 (0.3)	0.0 (0.0)	0.0 (0.0)
Government - Urban	313 (29.7)	30.7	7.4	58.1	3.5	0.3	3.6 (2.0)¬			2.3 (2.0)	1.8 (1.9)	0.1 (0.2)	0.0 (0.5)	0.0 (0.0)
Government - Rural	420 (39.9)	17.4	8.1	65.2	9.3	0.0	2.9 (2.0)¬^			2.4 (2.0)	2.4 (2.0)	0.2 (0.7)	0.0 (0.0)	0.0 (0.1)
Total	1053 (100)	25.7	7.9	61.2	5.1	0.1	3.5 (2.0)			2.5 (2.1)	2.0 (2.0)	0.1 (0.5)	0.0 (0.03)	0.0 (0.03)

Mann-Whitney U tests; *P<0.005, ^ P<0.001, ¬ P<0.001, Pd = Periodontal disease

Table 3. Distribution of children by age (5-6, 12-13-and 15-16-years-old) and periodontal conditions (CPI>0) according to socio-demographic variables, oral health behaviours and caries experience (dmft/DMFT=0, dmft/DMFT>0)

Independent variables	*5-6-year olds*		*12-13-year olds*		*15-16-year olds*	
	n=1025	*CPI>0*	*n=1037*	*CPI>0*	*n=1053*	*CPI>0*
	Mean % (95% CI)		*Mean % (95% CI)*		*Mean % (95% CI)*	
Gender						
Female	484	67.1 (63.1-71.1)	534	73.6 (69.8-77.3)	491	75.7 (71.8-79.4)
Male	541	67.1 (63.1-71.3)	503	73.8 (69.9-77.6)	562	74.4 (70.8-77.9)
School type and area						
Private urban	340	55.9 (50.6-61.2)	315	66.3 (61.1-71.6)	320	70.3 (65.3-75.3)
Government urban	277	64.3 (58.6-69.9)	312	70.2 (65.1-75.3)	313	69.9 (64.9-75.1)
Government rural	408	78.4 (74.4-82.4)	410	81.9 (78.2-85.7)	420	82.1 (78.5-85.8)
Physiographic division						
Upper hill	93	73.1 (64.0-82.2)	94	82.9 (75.3-90.6)	87	89.7 (83.2-96.1)
Middle hill	579	61.3 (57.3-65.3)	583	71.7 (68.0-75.4)	600	73.5 (69.9-77.0)
Terai	353	75.1 (70.5-79.6)	360	74.4 (69.9-78.9)	366	73.8 (69.3-78.3)
Mother's education						
Secondary/Tech/University			131	65.6 (57.5-73.8)	166	69.9 (62.9-76.8)
Primary/unfinished secondary			257	73.2 (67.7-78.6)	266	69.2 (63.6-74.7)
Illiterate			526	77.7 (74.2-81.3)	528	79.7 (76.3-83.1)
Don't know			123	65.8 (57.4-74.3)	92	72.8 (63.6-81.9)
Brushing frequency						
One or two time/day			1015	73.7 (70.9-76.4)	1046	74.8 (72.2-77.4)
Never/sometimes				72.7 (53.7-91.8)	7	85.7 (54.1-100)*
Use of fluoride toothpaste						
Fluoride			777	72.5 (69.3-75.6)	847	74.5 (71.6-77.4)
Non-Fluoride			260	77.3 (72.2-82.4)	206	76.7 (70.9-82.5)
Caries experience						
dmft/DMFT=0	436	66.9 (62.5-71.4)	757	72.5 (69.3-75.7)	750	74.9 (71.8-78.0)
dmft/DMFT>0	589	67.2 (63.4-71.0)	280	76.8 (71.8-81.7)	303	74.9 (70.0-79.8)

* 97.5% confidence interval (binomial distribution)

Table 4. Multiple logistic regression of periodontal conditions among schoolchildren aged 5-6, 12-13 and 15-16 years (n=1025, 1037, 1053) according to socio-demographic variables, oral health behaviours and caries experience. Dependent variable: No periodontal conditions (CPI=0) = 0 and periodontal conditions (CPI>0) = 1).

Independent variables	*Unadjusted OR 95% CI*	*Adjusted OR 95% CI*	*Unadjusted OR 95% CI*	*Adjusted OR 95% CI*	*Unadjusted OR 95% CI*	*Adjusted OR 95% CI*
Gender						
Female	1	1	1	1	1	1
Male	0.9 (0.8-1.3)	1.0 (0.7-1.3)	1.0 (0.8-1.3)	1.0 (0.7-1.4)	0.9 (0.7-1.2)	0.9 (0.7-1.2)
School type and area						
Private urban	1	1	1	1	1	1
Government urban	1.4 (1.0-1.9)*	1.5 (1.1-2.1)*	1.2 (0.8-1.7)	1.1 (0.7-1.5)	0.9 (0.7-1.4)	0.9 (0.7-1.4)
Government rural	2.8 (2.1-3.9)*	2.8 (1.9-4.1)*	2.3 (1.6-3.2)*	1.9 (1.3-2.9)*	1.9 (1.4-2.7)*	1.7 (1.1-2.5)*
Physiographic division						
Upper hill	1	1	1	1	1	1
Middle hill	0.6 (0.4-0.9)*	1.1 (0.6-1.9)	0.5 (0.3-0.9)*	0.9 (0.5-1.8)	0.3 (0.2-0.7)*	0.6 (0.3-1.2)
Terai	1.1 (0.6-1.8)	1.7 (0.9-2.9)	0.6 (0.3-1.1)	0.9 (0.5-1.7)	0.3 (0.2-0.7)*	0.5 (0.2-1.1)
Mother's education						
Secondary/Tech/University			1	1	1	1
Primary/unfinished secondary			1.4 (0.9-2.2)	1.2 (0.7-1.9)	0.9 (0.6-1.5)	0.8 (0.5-1.3)
Illiterate			1.8 (1.2-2.8)*	1.3 (0.8-2.1)	1.7 (1.1-2.5)*	1.3 (0.8-1.9)
Don't know			1.0 (0.6-1.7)	0.9 (0.5-1.6)	1.2 (0.7-2.0)	1.0 (0.6-1.8)
Brushing frequency						
One or two times a day			1	1	1	1
Never/sometimes			0.9 (0.4-2.5)	0.7 (0.2-1.9)	2.0 (0.2-16.8)	1.5 (0.2-13.2)
Use of fluoride toothpaste						
Fluoride			1	1	1	1
Non-fluoride			1.3 (0.9-1.8)	1.1 (0.8-1.6)	1.2 (0.8-1.6)	0.9 (0.6-1.4)
Caries experience						
DMFT = 0	1	1	1	1	1	1
DMFT > 0	1.0 (0.7-1.3)	1.2 (0.8-1.5)	1.3 (0.9-1.7)	1.2 (0.8-1.7)	0.9 (0.7-1.4)	0.9 (0.7-1.3)

*P<0.05, Nagelkerke R^2 a=7.3%, b=4.4%, c=4.4

(CPI > 0). The prevalence of periodontal conditions in 5 to 6, 12 to13 and 15 to16-year-olds were higher among school children studying in government schools and residing in rural areas when compared to those studying in government and private schools based in urban areas. Twelve to 13 and15 to 16-year-old schoolchildren living in upper hill regions experienced relatively greater periodontal conditions than their peers who lived in middle hill or terai regions. Similarly, children (12 to 13 and 15 to 16-year-olds) with illiterate mothers had comparatively higher proportion of periodontal conditions when compared to children whose mothers had attained higher education.

Table 4 shows the results of the multiple logistic regression analyses of 5 to 6, 12 to 13 and 15 to 16-year-old schoolchildren. The risk of experiencing bleeding on probing and calculus was greater for 5 to 6-year-olds who studied in government rural and government urban schools rather than for those studying in private urban schools. At ages 12 to 13 and 15 to 16 an increased risk (approximately two times) of experiencing CPI scores > 0 was observed when children studied in government rural schools as compared to those in private urban schools.

Discussion

This survey incorporated a larger number of examination sites and sample size than recommended by the WHO pathfinder approach to ensure that the survey provided a broad overview of the periodontal status. The possibility of sampling bias in this survey is acknowledged, since random selection of cities and villages was not performed. In Nepal, difficulties imposed by the rugged geography, lack of roads, unreliable transportation, inaccessible population, road blocks, lack of financial resources and insecurity due to the Maoist insurgency are barriers to a national survey based on multi-stage random proportional sampling technique. The periodontal status of schoolchildren may not be representative of the general population of children of the age groups studied since net enrolment rate for grades 1-10 is 61.1 (HMG, Ministry of Education and Sports, 2004). Information concerning the enrolment rates of the three age groups of this study was not available. No attempts were made to examine children who were not attending school and might result in some bias.

Examiner reproducibility for CPI expressed in the form of Kappa was not assessed in this periodontal survey. Studies have demonstrated that examiner reproducibility for bleeding on probing tends to be systematically low (Birkeland and Jorkjend, 1975; van der Velden, 1980). However, the examiners received six days of training and practice on all age groups in the application of the CPI Index and inter- and intra-examiner Kappa based on dmft/DMFT were good.

The periodontal health of Nepalese schoolchildren decreases with each age cohort. In Nepal the presence of calculus is ubiquitous and prevalent in all age groups surveyed. Mothers are not in the habit of brushing their young children's teeth nor do they supervise their children's brushing. Most Nepalis brush only in the morning and regular visits to clinics for oral care is not a norm, which may account for the high prevalence of calculus and the decline in healthy sextants with increasing age. However, there is a growing number of adolescents who report brushing more than once a day (39.1% of 12-13-year-olds and 44.3% of 15-16-year-olds) (Yee and Mishra, 2004).

The gradient in periodontal health observed in each age cohort based on area and school type, may be due to socio-economic differences. Children attending private urban schools come from wealthier families who can better afford to pay for private education and receive a better standard of education compared to their counterparts.

Children of all age groups living in rural areas had poorer periodontal status than those living in urban areas. Villalobos-Rodelo *et al*. (2007) showed that underprivileged children had worse oral hygiene compared to richer children and the amount of oral health information attained was positively associated to poverty. This finding corroborates well with our study as fewer dental services and organised oral health promotion programmes are available in rural areas of Nepal where the majority of the deprived live. This may consequently lead to a scarcity of information on oral health being disseminated to this group. Dolan *et al*. (1997) also showed that deprived populations residing in rural areas had poorer periodontium compared to those residing in urban areas. The present study indicates that 5-6 year-old children studying in government schools experienced more bleeding on probing and calculus than their peers studying in private schools. Previous epidemiological data from Nepal have not reported on the periodontal status of 5-6 year olds. Similarly, the poor periodontal status of Chilean adolescents was associated with schools receiving government support and the authors have postulated that this may be due to the poor socioeconomic background of the students (Lopez *et al*., 2001).

Other studies have shown that periodontal problems were more predominant among individuals who brushed fewer times and who experienced more dental caries (Lopez *et al*., 2006; Albander *et al*., 1995; Albander and Rams, 2002; Lopez and Baelum, 2006). No such associations were found in this study. Although, Lopez *et al*. (2006) observed that the risk of periodontal diseases was more pronounced among children with mothers of low education, our study revealed no such association. Socio-cultural differences and also the method used to measure periodontal status and mothers' education may have led to having no effect.

In conclusion, this study showed that 5 to 6-year-old schoolchildren studying in government rural and urban schools, and adolescents living in rural areas, and those studying in governmental schools were more likely to experience poorer periodontal status than their peers in private urban schools. Although the study did not explore differences in socio-economic status and periodontal status per se, the findings do suggest that certain socio-demographic dimensions and poverty may adversely impact on schoolchildren's periodontal health. Further studies may be required to comprehend the dynamic role of socio-economic factors on the periodontal health of schoolchildren in Nepal. The Oral Health Focal Point, Ministry of Health, will need to implement strategies that target rural residents in order to diminish socio-economic disparities in periodontal health. Oral health promotion

programmes adapted for rural Nepali schoolchildren may have the potential to reduce oral health disparities. Twelve year old schoolchildren involved in school-based oral health promotion programmes in China have demonstrated lower mean number of sextants with CPI Score 2 (Tai *et al*., 2001). Supervised school-based brushing with fluoride toothpaste have been effective in reducing dental caries and such programmes may also improve the periodontal status of schoolchildren in Nepal.

Acknowledgments

This study was supported by WHO SEARO, the United Mission to Nepal and the Department of Health Services, Ministry of Health, Government of Nepal.

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