International Dental Journal (2004) **54**, 83–89

Oral health status of children and adults in urban and rural areas of Burkina Faso, Africa

Benoît Varenne
Paris, France
Poul Erik Petersen
Geneva, Switzerland
Seydou Ouattara
Ouagadougou, Burkina Faso

Objectives: To analyse the oral health status of children and adults in rural and urban areas of Burkina Faso; to provide epidemiological data for planning and evaluation of oral health care programmes. **Design:** Cross-sectional survey including different ethnic and socio-economic groups. **Sample and methods:** Multistage cluster sampling of households in urban areas and random samples of participants selected based on the recent population census in rural areas. The final study population covered four age groups: 6 years (n = 424), 12 years (n = 505), 18 years (n = 492) and 35–44 years (n = 493). Clinical oral health data collected according to WHO methodology and criteria. **Results:** At age 6, 38% of children had caries, with prevalence higher in urban than rural areas. At age 12, the mean DMFT was 0.7 with prevalence significantly higher among urban than rural children. Mean DMFT was 1.9 in 18-year-olds and 6.3 in 35–44-year-olds and figures were higher for women than men. In adults, no differences in caries experience were found by location whereas the caries index was significantly affected by ethnic group and occupation. CPI score 2 (gingivitis and calculus) was dominant for all ages: 6 years (58%), 12 years (57%), 18 years (58%), 35–44 years (49%). In addition, 10% of 35–44-year-olds had CPI score 4. Rural participants had more severe periodontal scores than did urban individuals. **Conclusions:** Health authorities should strengthen the implementation of community-based oral disease prevention and health promotion programmes rather than traditional curative care.

Key words: Oral health, caries, periodontal diseases, Burkina Faso

Correspondence to: Dr. Professor Poul Erik Petersen, World Health Organisation, Non-Communicable Disease Prevention and Health Promotion, Oral Health Programme, 20 Avenue Appia, CH-1211 Geneva, Switzerland. E-mail: petersenpe@who.int

At the global level, marked changes in oral disease patterns have been observed over the past decades. In several industrialised countries the adult population maintain functional dentitions and significant reductions in rates of edentulousness are noted[1–3]. Furthermore, the prevalence and severity of dental caries of children have declined substantially in those countries[4], and the trend parallels the implementation of preventive oral care programmes and changing living conditions and lifestyles. For developing countries and especially in sub-Saharan Africa, the trend over-time in dental caries prevalence is not particularly clear. In the 1980s, some authors[5–7] reported that the situation was alarming for countries of this region due to growing prevalence rates and severity of oral disease. More recently, meta-analyses of oral health reports on studies carried out in Africa over the past 40 years revealed contrasting disease trends depending on country, population groups and socio-economic conditions[8–10]. Information on the prevalence of periodontal disease is more limited and the diagnostic criteria applied in surveys also show some variation[11]. Meanwhile, some studies

0020-6539/04/02083-07

suggested changing patterns of periodontal disease in parallel to the observations that more adults preserve their natural teeth[11].

In several West African countries, introduction of oral health programmes has not been given high priority by public health authorities. Oral health has mostly been considered through the establishment of emergency care facilities and sometimes supported by traditional curative care. Meanwhile, the majority of people living in rural areas have limited access to essential oral health care due to geographical and economic barriers. Preventive oral care programmes are rare and not made an integral part of public health services. As regards many countries of West Africa, oral epidemiological data are scarce and data are often not valid for cross-national comparisons[12]. In Burkina Faso, previously known as Upper Volta, three local surveys were conducted in 1983, 1987 and 1993. The studies on adults[13,14] showed that the standard of oral hygiene was poor, gingival problems were frequent whereas the prevalence rates of advanced periodontal disease and dental caries were low. More recently, in 1993, a local urban survey of schoolchildren showed a mean of 1.7 DMFT at the age of 12[15].

Like many developing countries, Burkina Faso is now in the process of establishing oral health systems based on the primary health care approach. Strategies are in line with the Bamako Initiative[16], which the government of Burkina Faso adopted in 1987. The Bamako Initiative launched by UNICEF and the World Health Organisation (WHO) aimed at improving access to essential health care and on contributions by the community to sharing of health services costs. Oral health projects have been initiated jointly by the Ministry of Health and Aide Odontologique Internationale (French NGO). The project activities are organised within the frame of the National Oral Health Programme and implemented in five provinces of the south-west region of the country. Epidemiological and sociological oral health data were collected at baseline in order to provide for situation analysis and the comparison of oral disease levels across social and ethnic groups. The objective of the present report is to evaluate the oral health status of well-defined population groups of the following ages: 6, 12, 18 and 35–44 years. The results of this study were to be used in the planning and evaluation of oral health promotion activities being part of the general health care action plan at district level.

Study population and methods

Burkina Faso is a landlocked country located in Sahelian Western Africa and covers an area of 274,000km^2. In 1996, the population was 10.3 million people with a growth rate of 2.4% per year. Most people (85%) live in rural areas and are mainly engaged in farming[17]. The official language is French but several local languages are spoken. The dominant religion is Islam, followed by Christianity and Animism. The country is ranked as one of the poorest developing countries of the world. In 2001, the ratio of dental practitioners per population was estimated at 1:200,000 inhabitants. There are 33 functional dental chairs in the country and dental care is offered by the 42 public health dentists working with the assistance of dental nurses trained at the National School of Public Health. Most dentists and dental nurses practice in the major two towns of the country where only about 10% of the total population reside[17]. The few private dentists are accessible only to rich people.

The actual survey was completed in 1999 and included five provinces of the south-west region of Burkina Faso covering a population of 1.5 million inhabitants (*Figure 1*). In this region, 25.7% of people are literate, 55% of the population are less than 17-years-old and the rate of schooling at the level of primary school is 42.8%. The most important ethnic groups of the country live in the study area, i.e. the groups of Mossis (31.7%), Sénoufos (15.6%), Bobo (14.5%) and Mandé (8.5%). The economy of the region mainly depends on the primary sector and the workers are occupied by cash crops (cotton), food crops (corn, sorghum, rice) and fruit gardens (mangoes, oranges)[18].

The survey was carried out in both urban and rural areas and participants were chosen by multistage cluster sampling. In urban areas, the two main towns of the region were selected: Bobo-Dioulasso (309,771 inhabitants) and Banfora (62,548 inhabitants). In Bobo-Dioulasso, the 25 districts were divided into four zones in order that the sample would include participants of different socio-economic status. In parallel, the six districts of Banfora were divided into two zones. Then, one district of each zone was randomly selected and within each district systematic selection of households took place as applied by the EPI 5 (Expanded Programme on Immunization)[19]. Five provinces were identified for the survey of participants in rural areas and the focal points for sampling were: Houet (34 sites), Comoé (16 sites), Kénédougou (29 sites), Leraba (14 sites), and Tuy (13 sites). One site was then randomly selected from each of the five provinces and random samples of people of the WHO standard ages were selected based on the recent population census. Thus eleven sampling sites were chosen for this study (six in urban areas and five in rural areas) and fifty persons were selected from each site and age group. The final sample included four age groups: 6 years (n = 424), 12 years (n = 505), 18 years (n = 492) and 35–44 years (n = 493).

Data were collected by clinical

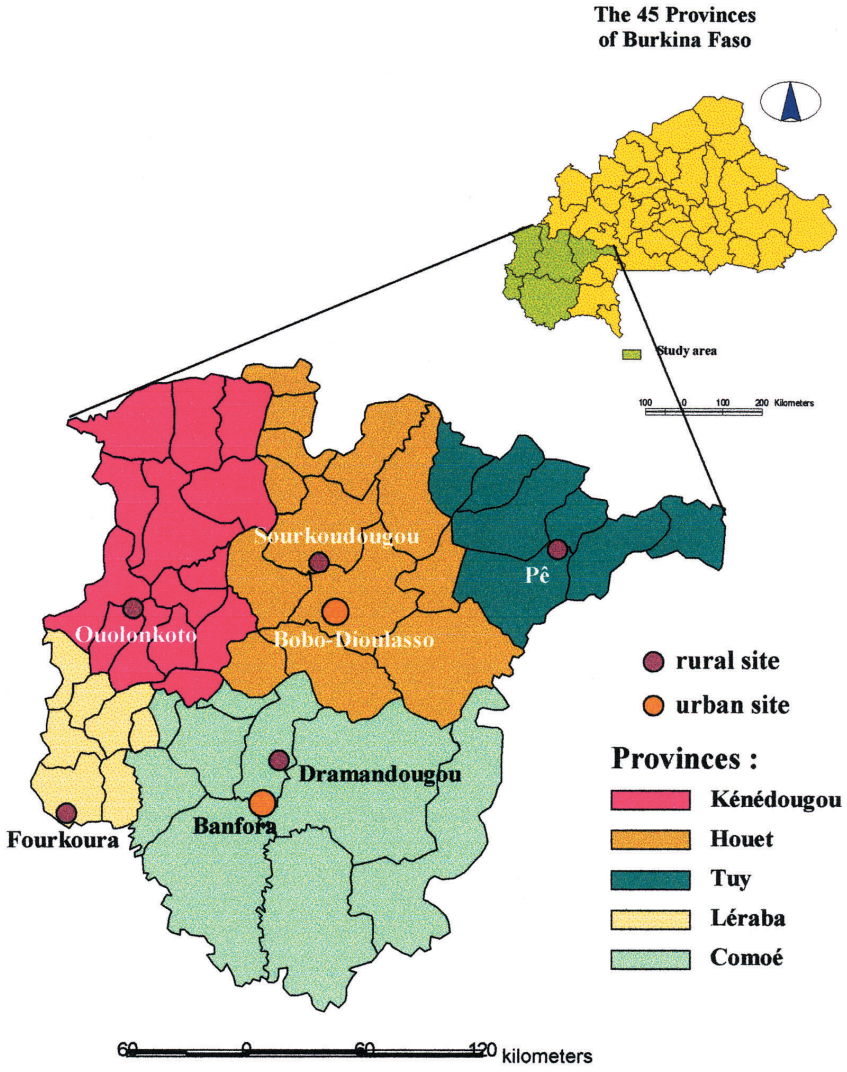

Figure 1. Map of study area

oral examinations. Information about oral health status, location, ethnic group and occupation was registered according to the WHO Oral Health Survey Basic Methods using the simplified oral health record form for children and the standard oral health record form for adults[20,21]. Dental status, dental caries and the Community Periodontal Index (CPI) were the conditions recorded. The scores of the CPI index are: score 0 = healthy; score 1 = gingival bleeding; score 2 = calculus; score 3 = shallow pocketing of 4–5mm and score 4 = deep pockets of 6mm or more. As regards the 6-year-olds, the presence of dental caries per individual was registered only and the periodontal examination included scores 0–2. The clinical examinations were carried out in daylight using plane mouth mirrors and the WHO recommended periodontal probe. The examinations were conducted by a team of four calibrated examiners. Calibration trials were performed initially to ensure inter-examiner reliability[21] and the Kappa consistency coefficient as regards dental caries was 89%. Samples of drinking water were selected from one well and from one drilling at each site. The level of fluoride was analysed at the Novartis Santé Familiale S.A. Laboratory in Rueil Malmaison (France) using High Performance Liquid Chromatography processing. The concentration of fluoride varied between 0.0024–0.27ppmF with an average of 0.10ppm.

The data were processed and analysed by use of the Statistical Package for the Social Sciences (SPSS-PC+) for Windows. The presence of dental caries in primary and permanent dentitions was measured by the prevalence proportion rates. Means of decayed, missing and filled teeth (DMFT) were calculated and the Community Periodontal Index scores were computed according to the WHO recommendations[21]. Bivariate and multivariate frequency distributions were used to analyse the data. The Student's t-test or ANOVA were applied for statistical evaluation of means and the Chi-Square test was used for comparisons of proportions.

Results

At age 6, the prevalence rate of dental caries was 38% and the figure was somewhat higher among urban than rural children ($p<0.01$) (*Table 1*). About two thirds of the young children had gingival bleeding and/or calculus, and one tenth needed immediate care. Among 6-year-olds, no significant differences were found in oral health status by gender while some effect of ethnic group was observed as regards the need for immediate care and the prevalence of CPI score 2 (*Table 2*). *Table 3* presents the prevalence proportion rates of dental caries and the mean caries experience for the participants aged 12, 18 and 35–44 years. For all age groups, the D-component constituted most of the caries index. The prevalence rates and the severity of dental caries are shown according to location and gender in *Table 4*. At age 12, both disease indicators were significantly higher for urban than rural children while significant differences by gender were found for the two adult groups only. *Table 5* describes the distribution of participants by maximum CPI score according to location. The proportion of individuals with severe CPI-scores was somewhat similar for people living in rural or

Table 1 Children aged 6 years distributed (Pct) by prevalence proportion rate of dental caries (PP), need for immediate care and maximum CPI score in relation to location.

Oral health indicator	Urban (n = 181)	Rural (n = 243)	Total (n = 424)
PP caries (Pct)	46**	32	38
Need for immediate care (Pct)	8	9	9
Maximum CPI score (Pct)			
Score 0	37	31	33
Score 1	8	10	9
Score 2	55	60	58

** $p < 0.01$

Table 2 Children aged 6 years distributed (Pct) by prevalence proportion rate of dental caries (PP), need for immediate care and maximum CPI score in relation to ethnic group.

Oral health indicator	Mossi (n = 71)	Mande (n = 129)	Bobo (n = 81)	Senoufo (n = 100)
PP caries (Pct)	44	33	35	43
Need for immediate care (Pct)	4	5	10	16*
Maximum CPI score (Pct)				
Score 0	38	36	28	24
Score 1	11	7	17	4
Score 2	51	57	54	72**

* $p < 0.05$ ** $p < 0.01$

Table 3 The prevalence proportion rate of dental caries (PP Pct) and mean dental caries experience (DMFT) of 12-, 18- and 35–44-year-olds in Burkina Faso (Standard Error of Mean in brackets).

Oral health indicator	12 years (n = 505)	18 years (n = 492)	35–44 years (n = 493)
PP caries (Pct)	28.5	53.9	72.8
DT	0.7	1.8	4.2
MT	0.01	0.06	1.9
FT	–	0.02	0.2
DMFT	0.7	1.9	6.3
(SEM)	(0.06)	(0.12)	(0.28)

Table 4 The Prevalence Proportion rate (PP) of dental caries (Pct) and mean caries experience (DMFT) by location, gender and age group.

			PP caries (Pct)	DMFT
12 years	Urban	(n = 293)	33.8*	0.9*
	Rural	(n = 212)	21.2	0.5
	Male	(n = 267)	26.6	0.6
	Female	(n = 238)	30.7	0.8
18 years	Urban	(n = 294)	53.1	1.8
	Rural	(n = 198)	55.1	1.9
	Male	(n = 228)	46.1	1.5
	Female	(n = 264)	60.6***	2.2*
35–44 years	Urban	(n = 247)	71.3	6.1
	Rural	(n = 246)	74.4	6.4
	Male	(n = 236)	63.1	4.4
	Female	(n = 257)	81.7***	8.0***

* $p < 0.05$ *** $p < 0.001$

Table 5 The distribution (Pct) of participants by Maximum CPI score in relation to age group and location.

	12 years			18 years			35–44 years		
Max CPI	Urban	Rural	*Total*	Urban**	Rural	*Total*	Urban***	Rural	*Total*
Score 0	26	17	*22*	19	12	*16*	4	2	*3*
Score 1	10	18	*13*	5	12	*8*	1	2	*2*
Score 2	58	56	*57*	60	55	*58*	58	39	*49*
Score 3	6	8	*7*	12	15	*13*	32	41	*36*
Score 4	0	1	*1*	4	6	*5*	5	16	*10*

** $p < 0.01$ *** $p < 0.001$

Table 6 Mean number of sextants per person with specific CPI scores according to age group.

CPI scores	12 years (n = 505)	18 years (n = 492)	35–44 years (n = 493)
Score 0	3.3	3.1	1.8
Score 1	0.9	0.7	0.4
Score 2	1.7	1.8	2.4
Score 3	0.1	0.3	1.0
Score 4	0.01	0.1	0.4

Table 7 The Prevalence Proportion (PP) rate (Pct) and mean DMFT of children and adults in relation to age and ethnic group in Burkina Faso.

Age	Indicator	Mossi	Mande	Bobo	Sénoufo	Others
12 years	PP (Pct)	39.1 *	22.4	22.6	31.1	24.1
	DMFT	0.8	0.6	0.4	0.9	0.8
	(n =)	(115)	(143)	(84)	(109)	(54)
18 years	PP (Pct)	39.4	45.7	54.5	43.9	49.3
	DMFT	2.1	1.9	1.4	2.2	1.4
	(n =)	(94)	(129)	(88)	(114)	(67)
35–44 years	PP (Pct)	74.6	68.3	83.3 *	73.5	64.5
	DMFT	6.4	5.4	6.5	6.8	6.2
	(n =)	(67)	(145)	(102)	(98)	(62)

* $p < 0.05$

Table 8 Mean DMFT and mean number of sextants with specific CPI scores of 35–44-year-olds according to occupation.

Indicator	Government employees (n = 49)	Shopkeepers (n = 46)	Professionals/ craftsmen (n = 61)	Farmers/ breeders (n = 142)	Housewives (n = 176)
DMFT***	3.6	6.6	5.8	4.5	8.3
CPI scores					
Score 0	2.4	1.4	1.7	1.8	1.8
Score 1	0.4	0.3	0.2	0.3	0.5
Score 2*	2.8	2.6	2.8	2.1	2.4
Score 3***	0.3	1.3	0.8	1.3	0.8
Score 4	0.04	0.1	0.1	0.3	0.2

* $p < 0.05$ *** $p < 0.001$

urban areas. In all age groups, about half of the individuals examined had gingival bleeding and calculus. The mean number of sextants with specific CPI scores is shown in *Table 6*. Finally, *Tables 7 and 8* indicate the association between oral health status and ethnic group and occupation. Shopkeepers had the highest mean caries experience index and had also high scores of severe periodontal conditions.

Discussion

The intention of the study was to provide systematic information on the oral health situation of children and adults in a region of Burkina Faso and that the results would aid the planning and evaluation of oral health promotion programmes. In developing countries, random sampling is mostly impossible due to lack of census lists or valid population registers and alternative procedures are needed to achieve

representative samples. For the present study a modified WHO pathfinder approach was chosen, i.e. representative focal points of urban and rural areas were identified in order to ensure the participation of the dominant ethnic groups of the country. A national pathfinder survey incorporates sufficient examination sites to cover all important subgroups of the population that may have differing disease levels or needs for care, and at least three of the index age groups[20,21]. In light of the coverage of important population groups, the size of the final study population and the high response rates the survey results may be considered relevant at national level. The epidemiological data were collected according to the WHO standard methods and criteria[20,21] and the recordings included dental caries and periodontal symptoms since these are highly relevant conditions in the planning of community oral health programmes. It is a global experience that this recording system may provide reliable data on the occurrence of oral disease. The WHO recommended level of inter-examiner reliability in registration of dental caries[21] was obtained in this study, meanwhile, the use of daylight during examinations could have resulted in an underestimation of caries.

Overall, the present survey has provided a valid overview of the oral health status at the population level. According to the WHO classification criteria[22], low to moderate levels of dental caries were found for all age groups examined. The differences in dental caries experience by ethnic groups were moderate whereas the effect of occupation was prominent among adults. Shopkeepers and professionals/craftsmen had relative high scores of dental caries against the lower caries experience of government employees. Such a pattern is in agreement with observations made in several industrialised countries[3]. The need for systematic care was clearly demonstrated; in children and adolescents the D-component constituted most of the dental caries experience while the M-component contributed about one third of the caries index in adults. This disease pattern highly reflects the fact that the population in Burkina Faso has poor access to restorative dental care and that radical treatment in terms of tooth extraction is mostly offered in case of symptoms from teeth.

Published studies[8–10] carried out in different countries south of the Sahara and north of the Republic of South Africa have shown that caries experience in the permanent dentition around the ages of 10–14 years ranges mainly from about 0.2 to 2.0 DMFT. The present findings on dental caries prevalence in 12-year-old children of Burkina Faso corresponds to results of similar studies in Western Africa[23–27]. However, the level of dental caries in children as well as in adults seemed somewhat low in Burkina Faso as compared with the findings of a national oral health survey conducted recently in the Republic of Niger[26]. As regards the adult population, the present study confirmed the previous observations of a relatively high caries index among women[26] and the higher caries experience score for women was primarily ascribed to more teeth having been extracted due to caries. In contrast to the study carried out in Niger only minor differences in prevalence rates of dental caries were observed between urban and rural adult groups examined in Burkina Faso, meanwhile, dental caries was more frequent among children of urban than rural areas. Finally, the actual oral epidemiological data are in agreement with oral health survey results from several countries of East Africa[28-31] but the dental caries figures are significantly lower than those found for children and adults in Madagascar[32].

The Community Periodontal Index (CPI) is an established measure for the assessment of periodontal problems in populations for which intervention programmes might be considered and the system records the treatable conditions. The major advantages of the CPI are simplicity, speed, reproducibility and international uniformity. In developing countries, the age profile implies that the age groups 15–19 years and 35–44 years are most important for assessment of periodontal health status. Consistent with CPI data reported for African children and adults of similar ages[11,14] the present survey demonstrated high levels of gingival bleeding and calculus and low scores of advanced periodontal symptoms. These prevalent conditions are preventable, primarily through proper oral hygiene and improved self-care practices. The periodontal conditions tended to be relatively poor among people living in rural areas and farmers and this may be explained by somewhat irregular oral hygiene practices.

In conclusion, the survey has indicated that the actual level of dental caries among children and adults in Burkina Faso is relatively low. Unfortunately, the epidemiological data available for the country[13–15] do not allow for valid time-trend analysis due to different principles of sampling and different criteria of recording oral disease. At present, the proportion of 6-year-old children being free of dental caries is significantly higher than the WHO goal for the year 2000 (i.e. at least 50% of children shall be caries free at age 6) and, in parallel, the caries experience of 12-year-olds is well within the WHO global goal of no more than 3 DMFT[33]. However, the need for dental care was evidenced for all age groups examined and the oral hygiene standard should be improved. In light of the scarce health resources and the current pattern of oral disease in Burkina Faso, health policy that emphasises oral health promotion and preven-

tion would seem more advantageous than traditional curative care. Affordable fluoridated toothpaste is highly recommended in order that the population may become appropriately exposed to fluoride and development of self-care capacity in oral health may be encouraged through establishment of community-based oral health education. It seems apparent that the oral health problems cannot be resolved if the delivery of health care is provided by dentists alone. Thus, the effective inclusion of primary health workers would play an important role in the delivery of preventive services. The health authorities of the country have given priority to improved oral health of children and several community demonstration projects are implemented. The results of the present survey may serve as a baseline for evaluation of such projects.

Acknowledgements

The study was supported by grants from Aide Odontologique Internationale; French Ministry of Foreign Affairs; European Commission; Ministry of Health, Burkina Faso, and the WHO Collaborating Centre for Community Oral Health Programmes and Research, University of Copenhagen, Denmark.

References

1. Walker A, Cooper I (eds). *Adult Dental Health Survey. Oral Health in the United Kingdom 1998*. London: The Stationery Office, Office for National Statistics, 2000.
2. US Department of Health and Human Services. *Oral Health in America: A Report of the Surgeon General*. Rockville: National Institute of Dental and Cranio-facial Research, National Institutes of Health, 2000.
3. Chen M, Andersen RM, Barmes D E *et al. Comparing oral health care systems. A second international collaborative study*. Geneva: World Health Organization, 1997.
4. Petersson GH, Bratthall D. The caries decline: a review of reviews. *Eur J Oral Sci* 1996 **104:** 436–443.
5. Barmes D E. Indicators for oral health and their implications for developing countries. *Int Dent J* 1983 **33:** 60–66.
6. Sheiham A. Changing trends in dental caries. *Int J Epidemiol* 1984 **13:** 142–147.
7. Heloe LA, Haugejorden O. "The rise and fall" of dental caries: some global aspects of dental caries epidemiology. *Community Dent Oral Epidemiol* 1981 **9:** 294–299.
8. Manji F, Fejerskov O. Dental caries in developing countries in relation to the appropriate use of fluoride. *J Dent Res* 1990 **69:** 733–741.
9. Fejerskov O, Baelum V, Luan W M *et al.* Caries prevalence in Africa and the People's Republic of China. *Int Dent J* 1994 **44:** 425–433.
10. Cleaton-Jones P, Fatti P. Dental caries trends in Africa. *Community Dent Oral Epidemiol* 1999 **27:** 316–320.
11. Pilot T, Barmes D E. An update on periodontal conditions in adults, measured by CPITN. *Int Dent J* 1987 **37:** 169–172.
12. Nithila A, Bourgeois D. WHO Global Oral Health Data Bank, 1986–96: an overview of oral health surveys at 12 years of age. *Bull World Health Organ* 1998 **76:** 237–244.
13. Abellard J, Decroix B, Kerebel LM. Enquête épidémiologique sur la santé bucco-dentaire à Fada N'Gourma (Burkina Faso). Bulletin du Groupement International Pour la Recherche Scientifique en Stomatologie et Odontologie 1989 **32:** 31–38.
14. World Health Organisation. *Global Oral Health Data Bank*. Geneva: WHO, 2000.
15. Tapsoba H, Bakayoko-Ly R. Oral health status of 12-year-old schoolchildren in the province of Kadiogo, Burkina Faso. *Community Dent Health* 2000 **17:** 38–40.
16. Nations Unies. Conseil économique et social, Fonds des Nations Unies pour l'enfance, comité du programme, session de 1988: recommandation au conseil d'administration pour la coopération au programme 1989–1993 «L'initiative de Bamako», E/ICEF/1988/P/L.40.
17. Institut National de la Statistique et de la Démographie (INSD). *Direction de la Démographie. Recensement général de la population et de l'habitation, 10–20 décembre 1996*. Ouagadougou, 2000.
18. Institut National de la Statistique et de la Démographie (INSD). *Direction des statistiques générales. Analyse des résultats d'enquête prioritaire sur les conditions de vie des ménages en 1998*. Ouagadougou, 2000.
19. Bennett S, Radalowicz A, Vella V *et al.* A Computer simulation of household sampling schemes for health surveys in developing countries. *Int J Epidemiol* 1994 **23:** 1282–1291.
20. World Health Organisation. *Oral health surveys – Basic Methods*. 3rd ed. Geneva: WHO, 1987.
21. World Health Organisation. *Oral health surveys – Basic methods*. 4th ed. Geneva: WHO, 1997.
22. Leclercq MH, Barmes DE, Sardo-Infirri J. Oral health: global trends and projections. *World Health Stat Q* 1985 **40:** 116–128.
23. Adegbembo AO, el-Nadeef MA, Adeyinka A. National survey of dental caries status and treatment needs in Nigeria. *Int Dent J* 1995 **45:** 35–44.
24. Matthesen M, Baelum V, Aarslev I *et al.* Dental health of children and adults in Guinea-Bissau, West Africa, in 1986. *Community Dent Health* 1990 **7:** 123–133.
25. Sembene M, Kane AW, Bourgeois D. Caries prevalence in 12-year-old schoolchildren in Senegal in 1989 and 1994. *Int Dent J* 1999 **49:** 73–75.
26. Petersen P E, Kaka M. Oral health status of children and adults in the Republic of Niger, Africa. *Int Dent J* 1999 **49:** 159–164.
27. Normark S. Social indicators of dental caries among Sierra Leone schoolchildren. *Scand J Dent Res* 1993 **101:** 121–129.
28. Frencken JE, Truin G-J, Sarita P *et al.* Caries prevalence in the deciduous dentition of a Tanzanian urban and rural child population in relation to levels of fluoride in drinking water in 1984, 1986 and 1988. *East Afr Med J* 1990 **67:** 237–245.
29. Chironga L, Manji F. Dental caries in 12-year-old urban and rural children in Zimbabwe. *Community Dent Oral Epidemiol* 1989 **17:** 31–33.
30. Frencken JE, Sithole WD, Mwaenga R *et al.* National oral health survey Zimbabwe 1995: dental caries situation. *Int Dent J* 1999 **49:** 3–9.
31. Schier M, Cleaton-Jones P. Dental caries in Namibia – the first national survey. *Community Dent Oral Epidemiol* 1995 **23:** 262–265.
32. Petersen PE, Razanamihaja N. Oral health status of children and adults in Madagascar. *Int Dent J* 1996 **46:** 41–47.
33. Fédération Dentaire Internationale/World Health Organisation. Global goals for oral health by the year 2000. *Int Dent J* 1982 **32:** 74–77.