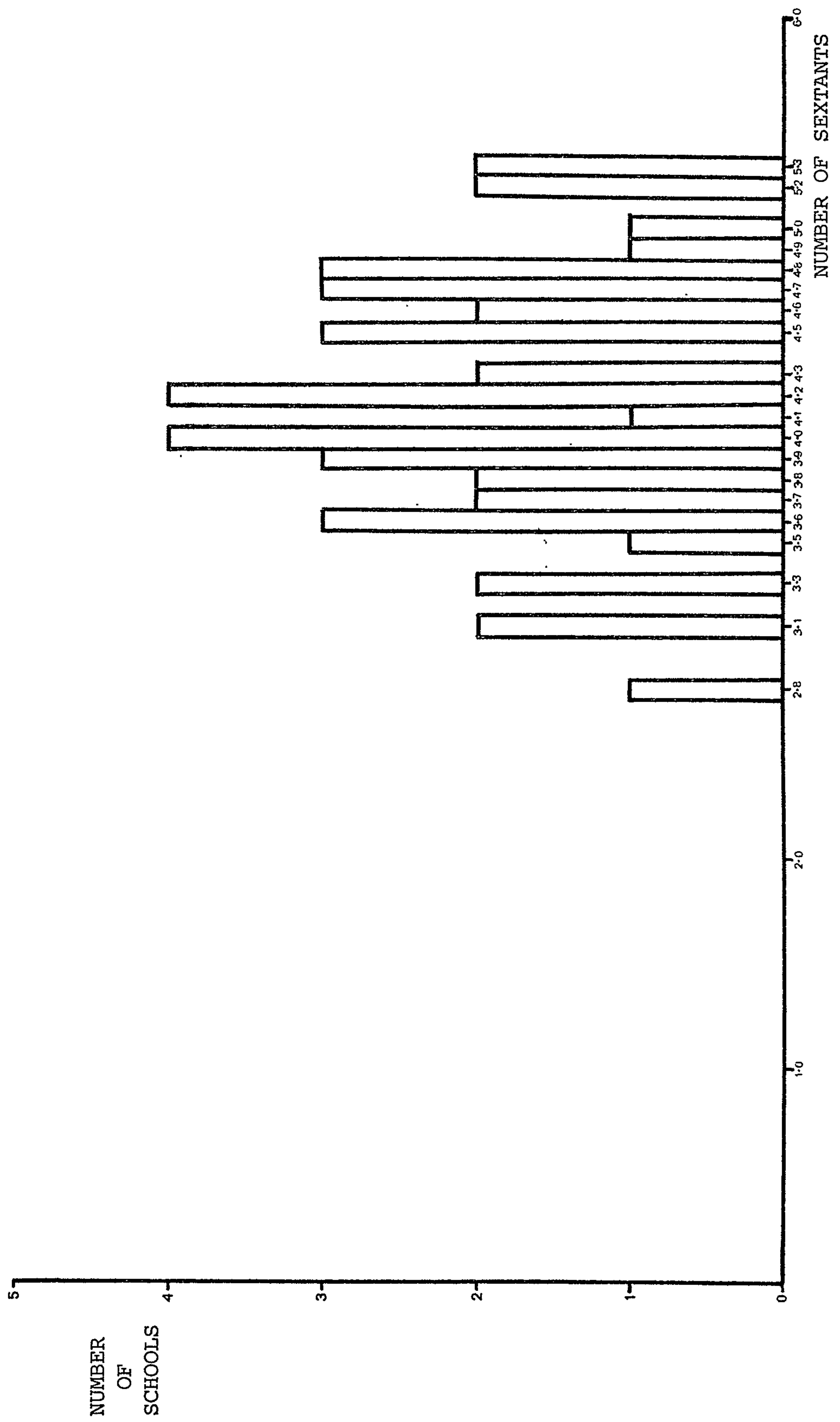


FIGURE 11 PERIODONTAL STATUS BY SCHOOL - FREQUENCY DISTRIBUTION BY MEAN NUMBER OF SEXTANTS
WITH PERIODONTAL DISEASE (GINGIVAL BLEEDING ONLY AND CALCULUS) - 11-14 YEARS
(SCHOOLS WHERE N < 30 EXCLUDED)



5.6.2 REPORTING OF STATISTICAL ANALYSIS

Statistical methods of analysis, similar to that for caries, were used for periodontal status data. The Chi Square test was the main method used to ascertain significance between defined population groups. Two sets of data were utilised: the number of persons affected by periodontal disease (all disease levels) i.e. persons with periodontal disease and persons without periodontal disease; and the number of persons affected by calculus i.e. persons with calculus and persons without calculus. Standard deviations (standard errors of the mean) for mean number of sextants affected by calculus were also calculated from school recordings. This enabled the identification and further analysis of those schools lying outside the 95.44% limit for both age groups. Tables 25 and 26 list the results of statistical analysis from which the following conclusions are drawn:

1. Periodontal status by age

Significance was found between the periodontal status of the 3 age groups. This is to be expected since periodontal disease prevalence generally increases with age.

2. Periodontal status by access

When data between the 5 access categories were compared, significance was found for both age groups. Survey data indicated that access code 5 had the highest periodontal disease prevalence and the worst disease severity levels amongst all the access categories. To further analyse the effects of access on periodontal disease, data for access code 5 was compared against those of other access categories individually. Also, path analysis was conducted between the access-altitude

categories of code 1-1 and code 5-1; and code 1-2 and code 5-2.

Results of these tests indicated strong significance between access code 5 and the other access categories in terms of calculus prevalence; some significance with regard to periodontal disease prevalence in the 11-14 years age group; and no significance with regard to periodontal disease prevalence in the 8-10 years age group.

The results of the above analysis would appear to confirm earlier data indications that periodontal disease prevalence and disease severity increased in areas with little access. Two factors may be responsible when no significance was indicated in tests involving the 8-10 years age group. These could be periodontal disease prevalence related to age, and smaller sample sizes.

3. Periodontal status by altitude

The minor variations in survey data between the 3 altitude categories were tested for significance. None was found.

4. Periodontal status by school

Utilising the 95.44% limit, no significance was found between the schools in the 8-10 years age group. However, 2 schools in the 11-14 years age group were found to be outside this limit. Further analysis using the Chi Square test confirmed that differences in calculus prevalence existed between the 2 schools and the rest. No significance was obtained for periodontal disease prevalence. Since both schools were located within access code 5, this further supports the view that lesser accessibility may increase periodontal disease prevalence in terms of disease severity.

5. Periodontal status - access by altitude

The access by altitude categories showing the lowest periodontal disease prevalence were compared with those with the highest prevalence i.e. Code 2-1 (lowest) with code 5-2 (highest) in the 11-14 years age groups; and code 2-1 (lowest) with code 5-1 (highest) in the 8-10 years age group. Significance found for calculus prevalence in both tests further strengthens the above stated relationship between areas with little access and periodontal disease.

Discussion

The effects of access on periodontal status may be explained in the following manner. In areas with good or reasonable access, services such as dental treatment and dental health education are generally more readily available than in those with little access. The former are likely to have greater exposure to health messages, and the practice of oral hygiene methods such as toothbrushing are more likely to occur. The latter would result in the reduction in amounts of plaque present in mouths, and consequently better periodontal health. Conversely, areas with little access rarely receive the benefits of general and dental health services. Also given the lack of traditional oral hygiene practices, such a situation may be conducive towards high periodontal disease prevalence.

Table 25 PERIODONTAL STATUS - RESULTS OF STATISTICAL ANALYSIS - CHI SQUARE TEST

Variable	Age group (yrs)	Disease severity level (presence of)	Probability level	Outcome
1. Age	3 age groups	Periodontal disease	$.05 > p > .02$	Reject Ho
	3 age groups	Calculus	$p < .001$	Reject Ho
2. Access				
Comparing 5 codes of access				
	11-14	Periodontal disease	$.5 > p > .02$	Reject Ho
	11-14	Calculus	$p < .001$	Reject Ho
	8-10	Periodontal disease	$.01 > p > .001$	Reject Ho
	8-10	Calculus	$.02 > p > .01$	Reject Ho
Code 1 (highway access) by Code 5 (no road and air access)				
	11-14	Periodontal disease	$.05 > p > .02$	Reject Ho
	11-14	Calculus	$p < .001$	Reject Ho
	8-10	Periodontal disease	$.9 > p > .8$	Accept Ho
	8-10	Calculus	$.01 > p > .001$	Reject Ho
Code 2 (mainroad access) by Code 5				
	11-14	Periodontal disease	$.1 > p > .05$	Accept Ho
	11-14	Calculus	$p < .001$	Reject Ho
	8-10	Periodontal disease	$.9 > p > .8$	Accept Ho
	8-10	Calculus	$.02 > p > .01$	Reject Ho
Code 3 (access road access) by Code 5				
	11-14	Periodontal disease	$.7 > p > .05$	Accept Ho
	11-14	Calculus	$.02 > p > .01$	Reject Ho
	8-10	Periodontal disease	$.9 > p > .8$	Accept Ho
	8-10	Calculus	$.01 > p > .001$	Reject Ho
Code 4 (no road access) by Code 5				
	11-14	Periodontal disease	$.05 > p > .02$	Reject Ho
	11-14	Calculus	$.01 > p > .001$	Reject Ho
	8-10	Periodontal disease	$.3 > p > .2$	Accept Ho
	8-10	Calculus	$.01 > p > .001$	Reject Ho

Table 25 continued

Variable	Age group (yrs)	Disease severity level (presence of)	Probability level	Outcome
Path analysis - cross tabulation data (access by altitude)				
Code 1-1 (highway access: < 1500m) by Code 5-1 (no road and air access: 1500m)				
	11-14	Periodontal disease	.9 > p > .8	Accept Ho
	11-14	Calculus	.05 > p > .02	Reject Ho
	8-10	Periodontal disease	.9 > p > .8	Accept Ho
	8-10	Calculus	.1 > p > .05	Accept Ho
Code 1-2 (highway access: 1501-1900m) by Code 5-2 (no road and air access: 1501-1900m)				
	11-14	Periodontal disease	.9 > p > .8	Accept Ho
	11-14	Calculus	.05 > p > .02	Reject Ho
3. Altitude				
Comparing 3 codes of altitude				
	11-14	Periodontal disease	.5 > p > .3	Accept Ho
	11-14	Calculus	.2 > p > .1	Accept Ho
	8-10	Periodontal disease	.1 > p > .05	Accept Ho
	8-10	Calculus	.7 > p > .5	Accept Ho
Code 1 (< 1500m) by Code 3 (> 1900m)				
	8-10	Periodontal disease	.3 > p > .2	Accept Ho
Code 2 (1501-1900m) by Code 3 (> 1900m)				
	8-10	Calculus	.9 > p > .8	Accept Ho
4. Schools outside 95.44% limit by age group sample				
Gobo (no road and air access: < 1500m)				
	11-14	Periodontal disease	.9 > p > .8	Accept Ho
	11-14	Calculus	.01 > p > .001	Reject Ho
Kosap (no road and air access: < 1500m)				
	11-14	Periodontal disease	.9 > p > .8	Accept Ho
	11-14	Calculus	.01 > p > .001	Reject Ho

Table 25 continued

Variable	Age group (yrs)	Disease severity level (presence of)	Probability level	Outcome
5. Access by altitude				
Code 2-1 (mainroad access: < 1500m) by Code 5-2 (no road and air access: 1501 - 1900m)				
	11-14	Periodontal disease	.3 > p > .2	Accept Ho
	11-14	Calculus	p < .001	Reject Ho
Code 2-1 (mainroad access: < 1500m) by Code 5-1 (no road and air access: 1501-1900m)				
	8-10	Periodontal disease	.9 > p > .8	Accept Ho
	8-10	Calculus	.01 > p > .001	Reject Ho

NB

1. Samples where N < 30 were excluded from statistical analysis
2. Level of significance determined at probability level of .05 or 5%
3. Ho = Null hypothesis
 - Accept Ho = no significance or likely differences in periodontal disease status between population groups
 - Reject Ho = significance or likely differences in periodontal disease status between population groups

Table 26 PERIODONTAL STATUS - RESULTS OF STATISTICAL ANALYSIS - SCHOOLS OUTSIDE 95.44% LIMIT

Age group (yrs)	Number of schools where N ≥ 30*	Mean number of sextants affected (calculus) - age group	Range for mean number of sextants affected (calculus) - schools	Standard deviation	95.44% limit (2 standard deviations)	Schools outside 95.44% limit
11-14	44	2.7	1.2 - 4.5	0.848	1.00 - 4.39	1. Gobo (4.4) 2. Kosap (4.5)
8-10	15	2.1	1.0 - 3.3	0.636	0.83 - 3.37	None

NB Standard deviation (standard error of the mean) is calculated from the formula:

$$\sqrt{\frac{\sum (x - \bar{x})^2}{N - 1}}$$

where x = mean number of sextants affected (calculus) for individual school

$\bar{x}$ = mean number of sextants affected (calculus) for age group

N = number of schools

* Schools where sample (N) < 30 were excluded from statistical analysis

5.6.3 SUMMARY

Periodontal status and treatment needs resulting from the survey's findings may be summarised as follows:

1. Periodontal disease prevalence was high for the total sample of the survey. The total percentage of persons affected was 98.6%. Of these, 11% was recorded as having gingival bleeding as the worst condition; 88% as having calculus as the worst condition; and less than 1% as having shallow and deep pockets.
2. Disease prevalence and severity increased with age, with 52% of persons affected by calculus at 6-7 years, 80% at 8-10 years, and 90% at 11-14 years.
3. The mean number of sextants affected by periodontal disease was 3.0 and over for all 3 age groups viz. 3.0 for 6-7 years (1.6 gingival bleeding only, 1.4 calculus); 3.9 for 8-10 years (1.8, 2.1); and 4.1 for 11-14 years (1.4, 2.7).
4. Treatment needs consisted of oral hygiene instruction, and prophylaxis only. 96-99% in all age groups required the former. The percentage of persons and mean number of sextants requiring prophylaxis were 52% and 1.4 for the 6-7 years age group, 80% and 2.1 for the 8-10 years age group, and 90% and 2.7 for the 11-14 years age group.
5. It would appear that periodontal status was influenced by the degree of accessibility in different geographical areas. Areas with little access registered higher periodontal disease prevalence and worse severity levels than those with greater access.

5.7 OTHER CONDITIONS

The data in this section is presented generally in the following manner:

1. By age - number and percentage of persons affected by the broad classifications of oral conditions as outlined below, and the number and percentage of persons requiring treatment.
2. By type - number of occurrences of specific oral conditions, and their rate of occurrence 1 in 10,000.

However, data on dental fluorosis will be presented according to age, access, altitude and access by altitude considerations.

5.7.1 DENTOFACIAL ANOMALIES

5.7.1.1 BY AGE (Table 27)

The percentage of persons affected for the total sample was 40%. The highest prevalence, 43%, was found in those between 11-14 years. The other 2 age groups shared the same prevalence score of 29%. Treatment needs were low, 0.4% of persons for the total sample, and were mainly confined to the 8-10 years and 11-14 years age groups. Such needs were usually for tooth extractions to relieve severe crowding. Treatment requirements may be considered as minimal estimates due to the general lack of an orthodontic treatment service involving appliances and banding.

5.7.1.2 BY TYPE (Table 28)

The prevalence of anomalies of dental arch relationship was low. The number of occurrences of the seven conditions observed were between 15

and 46. Both disto-occlusion and mesio-occlusion occurred in less than 2% of persons of the total sample. However, 2 conditions related to anomalies of tooth position were of note. Crowding (including imbrication), and spacing were found in 24% and 7% of the total sample respectively. The former was found in 1301 persons, and had a rate of occurrence of 2436 in 10,000. Corresponding figures for spacing were 394, and 738 in 10,000.

TABLE 27 DENTOFACIAL ANOMALIES BY AGE
NUMBER AND % OF PERSONS AFFECTED
NUMBER AND % OF PERSONS REQUIRING TREATMENT

Age (yrs)	N	absent	present	% persons affected	Treatment number	required %
6-7	52	37	15	29	0	0
8-10	1267	898	369	29	5	0.4
11-14	4021	2294	1727	43	14	0.3

% of persons of total sample affected - 40%

% of persons of total sample requiring treatment - 0.4%

TABLE 28 DENTOFACIAL ANOMALIES BY TYPE
NUMBER AND RATE OF OCCURRENCE - 1 in 10,000

ICD-DA code	Description of condition	Number of occurrence	Rate of occurrence 1 in 10,000
Anomalies of dental arch relationship			
524.20	disto-occlusion	44	82
524.21	mesio-occlusion	27	51
524.22	excessive overjet	15	28
524.23	excessive overbite	34	64
524.24	openbite	13	24
524.25	posterior crossbite	17	32
524.28	other malocclusion	46	86
Anomalies of tooth position			
524.30	crowding (includes imbrication)	1301	2436
524.31	displacement	43	81
524.32	rotation	131	245
524.33	spacing (includes diastema)	394	738
524.34	transposition	9	17
749.18	cleft lip without cleft palate - cleft lip scar	3	6
750.27	abnormal labial frenulum	101	189

5.7.2 CONDITIONS OF ORAL MUCOSA

5.7.2.1 BY AGE (Table 29)

The percentage of persons affected for the total sample was 54%.

Prevalence was highest for those persons between 11-14 years, 57% of persons affected, and lowest for those between 8-10 years, 44%.

Treatment was considered necessary for 5% of persons of the total sample. This consisted mainly of tooth extractions for dental abscesses, and included others such as removal of mucocoeles, palliative treatment for traumatic ulcers and recurrent aphthae, and treatment for acute necrotising ulcerative gingivitis. Only on 2 instances was a condition considered sufficiently severe as to warrant further investigation such as biopsies.

5.7.2.2 BY TYPE (Table 30)

Some conditions, either because of their high prevalence, or interest, are described as follows:

1. Excessive melanin pigmentation

This condition affected 41% of persons for the total sample. Its number and rate of occurrence were 2211, and 4140 in 10,000 respectively. The pigmentation was observed predominantly on the tongue, on the inner surfaces of the cheeks, and at times on both. For the tongue, pigmentation existed either as a single spot, several spots in one area, scattered, or generally distributed over the whole tongue. For the cheeks, pigmentation varied from small to large areas being involved, and was usually bilateral. The condition appeared to be a normal phenomenon amongst the survey's subjects.

2. Cheek biting

12% of persons in the survey were affected by this condition. It was found in 631 persons and has a rate of occurrence of 1182 in 10,000. This condition was usually bilateral. The degree of severity ranged from a small raised area near the molar region with little signs of trauma; a linear band of raised tissue extending right across the inner surfaces of the cheeks; and to a generally large hyperkeratinised area. At times, traumatic ulcers and/or minute haematomas were observed. These were usually associated with subjects exhibiting lesser cheek biting manifestations.

None of the subjects complained about the condition, and on questioning, it would appear the condition was painless. The reasons for the above prevalence of cheek biting are unclear. It may be attributed however, to the manner of eating in which large pieces of food are often placed inside the mouth requiring prolonged chewing.

3. Dental abscesses

Periapical abscesses without sinus, and those with sinus to oral cavity affected 0.7% and 2% of persons for the total sample. The sum of these 2 categories is 161 dental abscesses. From a total of 7613 carious primary and permanent teeth (calculated from Table 19), this represented 1 dental abscess for every 47 carious teeth.

4. Oral fistula (excludes oroantral fistula)

This condition was found in a small percentage of subjects (0.6%). It consisted of what appeared to be a residual fistula, which was located in the region of buccal unattached gingivae of upper permanent incisor teeth. The fistula may be as large as 2 mm in diameter and was mainly

found in the 11-14 years age group. Those persons between 6-7 years were unaffected. The fistula was symptomless and no discharge from it was apparent.

The above condition may be related, in the author's experience, to some instances when one or more upper permanent incisors were in the process of erupting in a young child. Their as yet unshed primary counterparts appeared at the same time to be "forced" or "pushed out" buccally, with the apical third of their roots exposed outside the labial gingivae. These primary teeth were invariably grossly carious, with little or no resorption of their roots.

TABLE 29 CONDITIONS OF ORAL MUCOSA BY AGE
 NUMBER AND % OF PERSONS AFFECTED
 NUMBER AND % OF PERSONS REQUIRING TREATMENT

Age (yrs)	N	absent	present	% persons affected	Treatment number	required %
6-7	52	28	24	46	4	7.7
8-10	1267	704	563	44	85	6.7
11-14	4021	1747	2274	57	153	3.8

% of persons of total sample affected - 54%

% of persons of total sample requiring treatment - 5%

TABLE 30 CONDITIONS OF ORAL MUCOSA BY TYPE
NUMBER AND RATE OF OCCURRENCE - 1 in 10,000

ICD-DA code	Description of condition	Number of occurrence	Rate of occurrence 1 in 10,000
Spirochaetal diseases			
101.x0	acute necrotizing ulcerative gingivitis	7	13
Benign neoplasms and tumour-like conditions			
210.00	upper lip vermilion border	4	7
210.01	upper lip labial mucosa	2	4
210.03	lower lip vermilion border	7	13
210.04	lower lip labial mucosa	1	2
210.05	lower lip vermilion border with mucosa	2	4
210.12	tongue-border and tip	10	19
210.40	buccal mucosa	5	9
210.43	gingiva	8	15
Pulp and perapical tissues			
522.5x	periapical abscess without sinus	40	75
522.72	periapical abscess with sinus to oral cavity	121	227
Disease of salivary glands			
527.60, 527.61	mucocoele (includes ranula)	17	32
Ulcers			
528.20	recurrent apthae	18	34
528.24	traumatic ulcer	29	54
Leukoplakia			
528.6x	leukoplakia	19	36
Other and unspecified			
528.93	cheek biting	631	1182
528.96	excessive melanin pigment- ation	2211	4140
528.97	oral fistula (excludes oroantral fistula)	31	58
Conditions of the tongue			
529.2x	median rhomboid glossitis	8	15
529.31	hypertrophy of tongue papillae - hairy tongue	4	7
529.5x	plicated (fissured, furrowed, scrotal) tongue	25	47
Congenital anomalies of tongue			
750.0x	tongue tie	1	2
750.14	congenital macroglossia	3	6
750.15	congenital microglossia	1	2

5.7.3 DEFECTS AND ABNORMALITIES OF TEETH BY AGE (EXCLUDING ENAMEL HYPOPLASIA AND FLUOROSIS)

5.7.3.1 BY AGE (Table 31)

The percentage of persons affected for the total sample was 25%. Prevalence was highest in the 11-14 years age group, with 28% of persons affected, and lowest in the 6-7 years age group with 4%. Those between 8-10 years recorded 15%. Treatment needs, 0.5% of persons for the total sample, were low. They mainly consisted of treatment for tooth injuries, and extraction of supernumerary teeth where indicated.

5.7.3.2 BY TYPE (Table 32)

The conditions showing significant prevalence levels when compared to others are as follows:

1. Tooth fracture (includes both primary and permanent teeth)

The two most prevalent categories were those with fracture of enamel only, and with fracture of tooth crown without pulpal involvement. They affected 7.5% and 3% of persons in the survey respectively. Recordings of more severe categories such as those with pulpal and root involvement were minimal.

2. Abnormalities of size and form

The 3 most prevalent conditions under this classification were dens evaginatus, dens invaginatus and premolarisation. They were often bilateral. Dens evaginatus manifested itself usually as an enamel covered conical tubercle found on the occlusal surfaces of lower

premolar teeth. All 4 premolars in the same person may be affected. Dens invaginatus often appeared as peg shaped lateral incisors in the maxilla, and as T-shaped lateral incisors in the mandible. Finally, premolarisation was normally only found in lower premolars where the latter appeared to be "elongated" in the mesio-distal aspect.

3. Supernumerary teeth

The number of supernumerary teeth in all regions of the dentition was 114. This approximated to 2% of persons affected in the survey. Most supernumerary teeth were found in the incisor canine region, with the least in the premolar region.

Finally, recordings of enamel hypoplasia in the form of Hutchinson's incisors and Mulberry molars are included in Table 32 for convenience.

TABLE 31 DEFECTS AND ABNORMALITIES OF TEETH BY AGE
(EXCLUDING ENAMEL HYPOPLASIA AND FLUOROSIS)
NUMBER AND % OF PERSONS AFFECTED
NUMBER AND % OF PERSONS REQUIRING TREATMENT

Age (yrs)	N	absent	present	% persons affected	Treatment number	required %
6-7	52	50	2	4	0	0
8-10	1267	1083	184	15	5	0.4
11-14	4021	2891	1130	28	20	0.5

% of persons of total sample affected - 25%

% of persons of total sample requiring treatment - 0.5%

TABLE 32 DEFECTS AND ABNORMALITIES OF TEETH BY TYPE (EXCLUDING ENAMEL HYPOPLASIA AND FLUOROSIS)
NUMBER AND RATE OF OCCURRENCE 1 IN 10,000

ICD-DA code	Description of condition	Number of occurrence	Rate of occurrence 1 in 10,000
Manifestations of infectious disease			
090.51	Hutchinson's incisors	21	39
090.52	Mulberry molars	33	62
520.00	Partial anodontia	26	49
Supernumerary teeth			
520.10	Incisor and canine regions	52	97
520.11	Premolar region	21	39
520.12	Molar region	41	77
Abnormalities of size and form			
520.20	Macrodonia	33	62
520.21	Microdonia	45	84
520.22, 520.33	Concresence, fusion and germination	28	52
520.24	Dens evaginatus (excludes tuberculum carabelli)	85	159
520.25	Dens invaginatus (includes peg shaped and T shaped incisors)	134	250
520.26	Premolarization	91	170
520.27	Abnormal tubercula and enamel pearls (excludes dens evaginatus and tuberculum carabelli)	63	118
520.28	Taurodontism	11	21
520.63	Retained primary teeth	41	77
521.10	Excessive occlusal attrition	24	45
Tooth fracture (includes both primary and permanent teeth)			
873.60	Fracture of enamel of tooth only (includes enamel chipping)	401	751
873.61	Fracture of crown of tooth without pulpal involvement	65	309
873.62	Fracture of crown of tooth with pulpal involvement	15	28
873.63	Fracture of root of tooth	3	6
873.64	Fracture of crown and root of tooth	1	2

5.7.4 ENAMEL HYPOPLASIA (INCLUDING FLUOROSIS) BY AGE (Table 33)

The percentage of persons affected for the sample was 86%. There was little difference in prevalence between the 3 age groups, with rates of occurrence ranging from 83-86%. Treatment needs, 0.5% of persons for the total sample, were low. Such needs may be regarded as minimal estimates. Aesthetic treatment was not considered a viable option due to dental health services constraints. Only cases deemed having a functional or caries problem were identified as requiring treatment.

Due to a misunderstanding with the WHO, data pertaining to the different types of enamel hypoplasia and opacities (see Section 4) could not be recovered. Hence a discussion of enamel hypoplasia by type and by tooth distribution is not possible. However, recollections by this author suggested that all types of enamel hypoplasia were observed, and they affected both sets of dentition. One or several teeth in a person may be affected, and the hypoplasia may or may not be bilateral.

TABLE 33 ENAMEL HYPOPLASIA BY AGE (INCLUDING FLUOROSIS)
NUMBER AND % OF PERSONS AFFECTED
NUMBER AND % OF PERSONS REQUIRING TREATMENT

Age (yrs)	N	absent	present	% persons affected	Treatment number	required %
6-7	52	8	44	85	1	2
8-10	1267	213	1054	83	3	0.2
11-14	4021	545	3476	86	21	0.5

% of persons of total sample affected - 86%

% of persons of total sample requiring treatment - 0.5%

5.7.5 FLUOROSIS BY AGE, ACCESS, ALTITUDE, SCHOOL, AND ACCESS BY ALTITUDE (Table 34 AND Appendices 38-42)

The prevalence of fluorosis for the total sample appeared to be low despite enamel hypoplasia being widespread throughout the survey subjects. The percentage of persons recorded as being free from fluorosis i.e. "normal" was 85%. Those observed as "questionable" was 12%, "very mild" 2% and "mild" 1%. Only 15 persons in the whole survey had a "moderate" score. No recording was made of "severe" fluorosis. Variations in terms of prevalence and severity were minimal between the 3 age groups; and within the different access categories, altitude categories, and access by altitude categories.

5.7.5.1 COMMUNITY FLUOROSIS INDEX (Table 35)

The community fluorosis index was calculated for the different variables above. The method used, as devised by Dean (Moller 1982) is illustrated by the following example:

The community fluorosis index for the total sample:

Fluorosis category	Numerical weight (w)	Frequency (f) (number of persons affected)	f x w
Normal	0	4533	0
Questionable	0.5	650	325
Very mild	1	99	99
Mild	2	43	86
Moderate	3	15	45
Severe	4	0	0
Total		5340	555

Community fluorosis index = $\frac{\sum f \times w}{n}$ where n = number of persons examined

= $\frac{555}{5340}$

= 0.10

The scores for the community fluorosis indices obtained were low. They ranged from between 0.03 - 0.11 by age; 0.08 - 0.11 by access; 0.08 - 0.12 by altitude; and 0.04 - 0.17 for access by altitude categories. The "public health significance" of community fluorosis index scores, in terms of fluorosis prevalence and severity levels, were determined using Dean's criteria (Striffler, Young, Burt 1983).

Range of scores for community fluorosis index	Public health significance
0 - 0.4	Negative
0.4 - 0.6	Borderline
0.6 - 1.0	Slight
1.0 - 2.0	Medium
2.0 - 3.0	Marked
3.0 - 4.0	Very marked

From the above, it can be seen that the fluorosis prevalence and severity levels found in the survey could be regarded as having "negative" public health significance.

The fluoride concentration of water sources in geographical areas covered by the survey were not known. This prevented their comparison with the calculated community fluorosis index scores.

TABLE 34 FLUOROSIS BY AGE
NUMBER AND % OF PERSONS AFFECTED

Age (yrs)	N	Fluorosis					
		Normal W	Questionable Q	Very Mild VM	Mild M	Moderate MO	Severe S
6-7	52	49	3	0	0	0	0
8-10	1267	1113	129	13	7	5	0
11-14	4021	3371	518	86	36	10	0
Total	5340	4533	650	99	43	15	0
%	100	85	12	2	1	0	0

TABLE 35 COMMUNITY FLUOROSIS INDEX - BY TOTAL SAMPLE, AGE, ACCESS, ALTITUDE, AND ACCESS BY ALTITUDE

Description	Sample size (N)	frequency of persons affected x numerical weight (f x w)	Community fluorosis index	Public health significance *
Total sample				
Age (years)				
6-7	52	1.5	0.03	Negative
8-10	1267	130.5	0.10	Negative
11-14	4021	447	0.11	Negative
Access				
code 1	918	98	0.11	Negative
code 2	1830	185.5	0.10	Negative
code 3	1867	211.5	0.11	Negative
code 4	349	31.5	0.09	Negative
code 5	376	28.5	0.08	Negative
Altitude				
code 1	1226	99	0.08	Negative
code 2	3237	351.5	0.11	Negative
code 3	877	104.5	0.12	Negative
Access by altitude				
code 1-1	120	9.5	0.08	Negative
code 1-2	757	81.5	0.11	Negative
code 1-3	41	7	0.17	Negative
code 2-1	400	30	0.08	Negative
code 2-2	1130	120	0.11	Negative
code 2-3	300	35.5	0.12	Negative
code 3-1	206	15	0.07	Negative
code 3-2	1285	140.5	0.11	Negative
code 3-3	376	56	0.15	Negative
code 4-1	185	25.5	0.13	Negative
code 4-3	160	6	0.04	Negative
code 5-1	311	18	0.06	Negative
code 5-2	65	7.5	0.12	Negative

* Based on Dean's Public Health Significance of Community Fluorosis Index Scores (Striffler, Young, Burt 1983)

5.7.6 BONE ABNORMALITIES (TABLES 36 and 37)

Bone abnormalities were found to be extremely rare and affected only 0.07% of persons for the total sample.

TABLE 36 BONE ABNORMALITIES BY AGE
NUMBER AND % OF PERSONS AFFECTED
NUMBER AND % OF PERSONS REQUIRING TREATMENT

Age (yrs)	N	absent	present	% persons affected	Treatment number	required %
6-7	52	52	0	0	0	0
8-10	1267	1264	3	0.2	1	0.07
11-14	4021	4020	1	0.02	0	0

% of persons of total sample affected - 0.07%

% of persons of total sample requiring treatment - 0.02%

TABLE 37 BONE ABNORMALITIES BY TYPE
NUMBER AND RATE OF OCCURRENCE - 1 in 10,000

ICD-DA Code	Description of condition	Number of occurrence	Rate of occurrence 1 in 10,000
526.81	Torus mandibularis	1	2
526.82	Torus palatinus	2	4
526.83	Exostosis	1	2

6 DISCUSSION

6.1 DESIGN AND CONDUCT OF SURVEY

Certain problems are inherent in any large scale dental health survey. This was especially pertinent in this study given the large sample and the small number of survey personnel; survey personnel who were inexperienced in dental health surveys; the vast distances that had to be negotiated in difficult terrain; and the uncertainty of subject response rates. However, the intended sample size was achieved mainly due to the excellent cooperation from the provincial education authorities and teaching staff. Also, the survey and clinical procedures followed in the survey proved to be practical, easy to administer, and inexpensive.

Factors considered significant with regard to the design and conduct of the survey were as follows:

1. Examiner calibration

There was extensive calibration between the 2 examiners prior to the start of the survey. Statistical analysis of data suggested that there were minimal differences in assessment variation between them. However, discrepancies in subject numbers in the "End" stage of the survey, caused probably by the incorrect filling in of forms, prevented a more accurate confirmation of the latter.

2. Sample selection

a. The low number of subjects examined in the 6-7 years age group (N = 52) prevented better definition of the oral health status of this

group. This is because children are normally older when they attend school in Papua New Guinea than in Western countries.

b. The age groups examined e.g. 11-14 years instead of say 12 years, rendered general comparisons with other studies difficult.

Physiologic dental age groupings were used because of the general unavailability of birth dates amongst the sample.

c. The access and altitude variables were crude indicators used to ensure some degree of representativeness of the sample in relation to the population groups in the province. The variables served as an attempt to relate dental health status to cultural and lifestyle differences, diet and food habits, and the general accessibility to services e.g. health and dental care etc. Since this was a baseline prevalence study, no attempt was made to define the variables better. Better definition might have included the establishment of the absence/presence of tradestores in close proximity to schools, the amount and frequency of fermentable carbohydrate intake, the general types of food eaten, meal patterns, the access to dental care etc.

3. Sample size

In hindsight, and with a greater understanding of public health principles, the total sample examined was probably in excess of what was needed to achieve the principal aims of the study.

4. Budgetary constraints prevented the analysis of fluoride levels in the various water sources. This resulted in the inability to assess the relationship between caries experience and fluoride levels.

5. The assessment of fluorosis was difficult owing to ignorance of natural fluoride levels, and the widespread prevalence of enamel hypoplasia.

6. Difficult communication, and misunderstanding with the WHO, resulted in loss of data regarding one school, and the prevalence of enamel hypoplasia by type.

Finally, despite the above imperfections, it is felt that the principal aim of the study was achieved i.e. the establishment of the oral health status, and treatment needs of the sample surveyed. Such information will also enable discussion of the implications for dental care in the province.

6.2 COMPARISON OF SURVEY DATA

Comparison of survey data will be made with other studies in Papua New Guinea; selected South Pacific island states; and current global oral disease trends and patterns. Discussion of data concerning periodontal disease and other conditions will, in most cases, be of a general nature. This is due to a lack of, or unsuitable data. Also, for periodontal disease, this survey utilised the CPITN assessment method, an index only introduced since 1982. Assessment of periodontal disease in studies prior to this date would have employed other methods, hence making comparisons difficult. However, more critical comparison will be made of caries experience in the permanent dentition. To accomplish the latter, it was first necessary to derive assumed age specific age group mean DMFT values. This was due to the nature of the age groups examined in the survey, which encompassed several ages within an age group.

6.2.1 ASSUMED MEAN DMFT VALUES (See Figure 12)

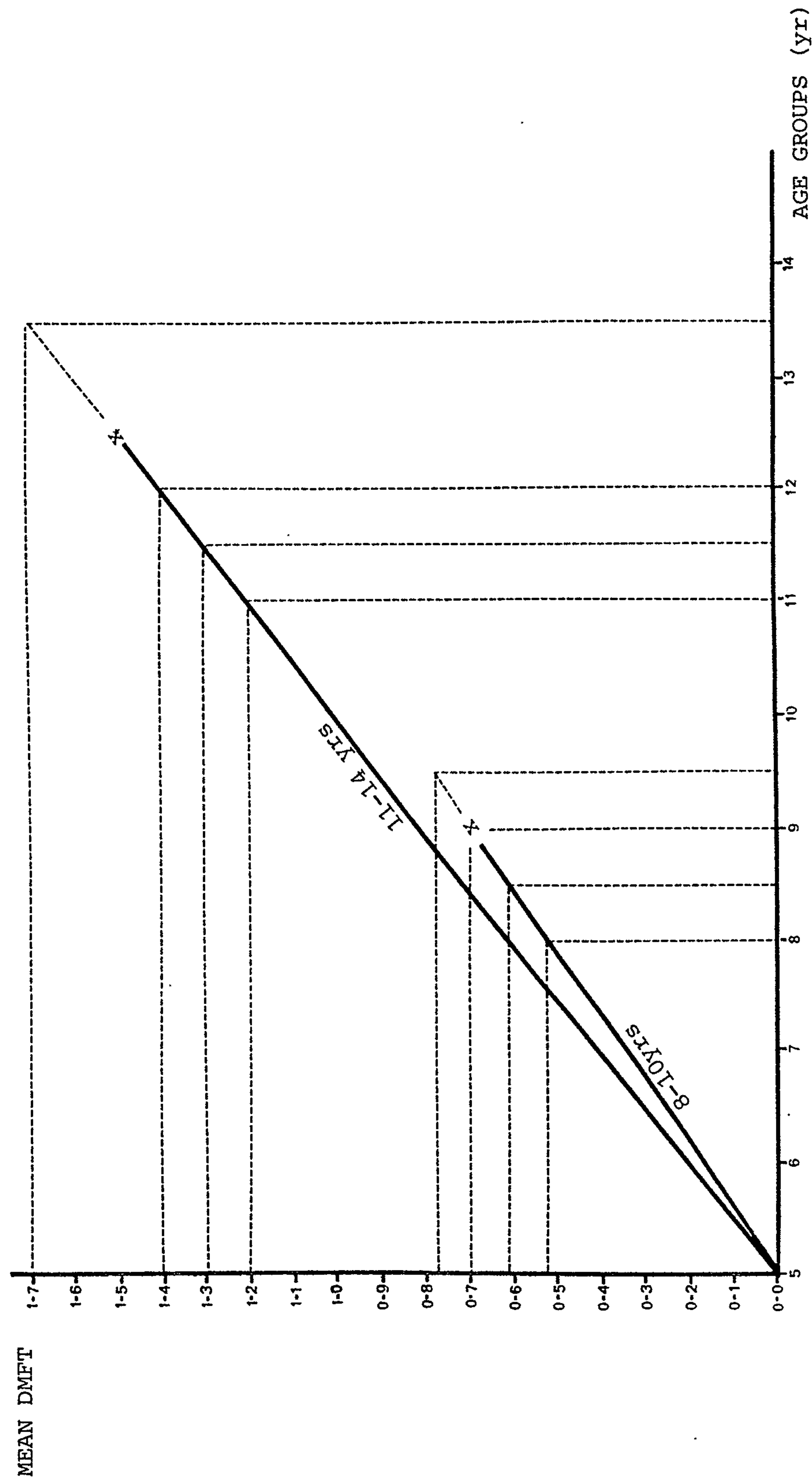
Survey data indicated that the mean DMFT value for the 6-7 years age group was 0.8; 8-10 years age group 0.7; and the 11-14 years age group 1.5. In order to obtain assumed age specific age group mean DMFT values, the following criteria and assumptions were followed:

1. An equal number of subjects of each age within each group was examined.
2. There was a linear progression in caries experience within each age group.
3. The mean DMFT value for the 5 years age group was 0.
4. Owing to the small number of subjects examined in the 6-7 years age group, the 6 and 7 year age groups were assumed to have a mean DMFT value of 0.8.
5. The mean DMFT value of the midpoints of the 8-10 years and 11-14 years age groups were assumed to represent those values obtained from survey data i.e. the $12\frac{1}{2}$ years age group had the mean DMFT value of 1.5, and the 9 years age group 0.7
6. The assumed mean DMFT value for comparison with studies involving a non age specific age group, was the midpoint of the latter. For example, the assumed mean DMFT value for the 7 years age group will be used when comparing data with a 5-9 years age group.

With the above criteria, a graph was plotted (Figure 12) for the 8-10 years and 11-14 years age groups. This allowed for assumed age specific age group mean DMFT values between the age groups of 8 and 14 to be derived. Hence, assumed mean DMFT values to be used later for comparisons are as follows:

Age group (years)	Assumed mean DMFT value
6	0.8
7	0.8
8	0.5
8½	0.6
9	0.7
9½	0.8
11	1.2
11½	1.3
12	1.4
13½	1.7

FIGURE 12 CARRIES STATUS BY AGE - ASSUMED DMFT VALUES



6.2.2 COMPARISON WITH OTHER REGIONS OF PAPUA NEW GUINEA

Comparison of survey data within Papua New Guinea is limited due to the small number of epidemiological studies conducted, and is mainly restricted to discussion of caries experience in the permanent dentition.

6.2.2.1 CARIES EXPERIENCE

Table 38 compares the assumed mean DMFT values of the survey with those of the 4 most recent epidemiological studies - two involving the islands region (Bailet et al 1968; Anderson 1970), one in the highlands (Malden 1983), and the national dental survey (Humphreys 1977). It would appear from the table that caries experience was greater in Western Highlands Province (WHP) than that in the islands and the Southern Highlands, and was above that of the national average value obtained a decade ago.

Table 39 allows further comparison between the survey's findings and caries data of other provinces obtained from the national dental survey. It can be seen that, with the exception of the North Solomons and the National Capital, the caries experience at 8 years in WHP was generally higher than that of coastal and island provinces. Of the highland provinces, caries experience of WHP was higher than that of the Southern Highlands, similar to those of Chimbu and the Eastern Highlands, and lower than that of Enga. Comparison of mean DMFT values of WHP of this survey and that of the national dental survey also suggested rising caries experience in the province.

From the above, one could tentatively suggest that caries experience in WHP was generally higher than that of coastal and island regions.

However, all but one of the studies used for comparison are dated, and were conducted between 1968-1977. Since this time, caries prevalence might have been expected to increase in these regions due to further Westernisation, and the associated increased consumption of fermentable carbohydrates.

Finally, findings of the national dental survey indicated that 90% of dental decay in the primary dentition, and 42-75% in the permanent dentition, was untreated. The respective DT/DMFT percentage values for this survey were 94-96% and 75-86%.

6.2.2.2 OTHER CONDITIONS

Two observations by Anderson are of note. He estimated that 92.7% of his sample had normal occlusion and there was a virtual absence of Class II and III malocclusions. His findings also indicated that 74% of the sample had oral pigmentation. In this survey, persons affected by mesio-occlusion and disto-occlusion only amounted to 1.3%. 41% of persons were recorded as having excessive oral melanin pigmentation.

Finally, the high prevalence of enamel hypoplasia recorded in the survey would appear consistent with previous studies conducted in the country.

TABLE 38 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH OTHER REGIONS OF PAPUA NEW GUINEA

Study	Region	Age group (yrs)	Mean DMFT	Age group midpoint (yrs)	Mean DMFT (WHP)*
1. Bailit, Ogan, Leigh (1968)	North Solomons	5-14	0.7	9½	0.8
2. Anderson (1970)	Islands (New Britain, New Ireland, North Solomons)	5-9 10-14	0.2 1.1	7 12	0.8 1.4
3. Malden (1983)	Southern Highlands: Males	7 12	0.5 0.5	- -	0.8 1.4
	Females	7 12	0.3 0.7	- -	0.8 1.4
4. Humphreys (1977)	Whole country: urban rural	6-10 6-10	0.4 0.3	8 8	0.5 0.5

* assumed mean DMFT values derived from Figure 12

TABLE 39 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH THE NATIONAL DENTAL SURVEY 1977

Region	Province	Mean DMFT
	(WHP) 1983	0.5
Islands	North Solomons - urban	0.5
	- rural	0.4
	East New Britain - urban	0.1
	- rural	0.1
	New Ireland - rural	0.2
Coastal (mainland)	National Capital - urban	0.8
	East Sepik - urban	0.0
	- rural	0.1
	Madang - urban	0.2
	- rural	0.1
	Milne Bay - urban	0.5
	- rural	0.2
	Morobe - urban	0.5
	- rural	0.2
	Western - urban	0.1
	- rural	0.3
Highlands (mainland)	Chimbu - urban	0.3
	- rural	0.5
	Eastern Highlands - urban	0.4
	- rural	0.5
	Enga - urban	0.8
	- rural	0.8
	Southern Highlands - urban	0.2
	- rural	0.3
	Western Highlands - urban	0.3
	- rural	0.3

NB 1. National dental survey 1977 - age group examined = 6-10 yrs
- mid point of age group examined
= 8 yrs

3. Assumed mean DMFT for present WHP survey at 8 yrs = 0.5
(Figure 12)

Source: Humphreys 1977
Prevalence survey on the dental health status of primary
school children in Papua New Guinea
Department of Health: Papua New Guinea

6.2.3 COMPARISON WITH SOUTH PACIFIC NATIONS

Because of Papua New Guinea's geographical position, comparison of survey results will be made with those of the South Pacific nations. For convenience, comparison will be made with those island nations which belonged to the now defunct South Pacific Commission. The latter, formerly a consultative and advisory body on the improvement of well being of peoples of member status, embraced 12 million square miles and 10,000 islands. It was bounded by Papua New Guinea to the west; Pitcairn Island to the east; the Mariannas to the north; and Norfolk Island to the south.

6.2.3.1 CARIES EXPERIENCE

Tables 40 and 41 compare the survey's findings with those of studies conducted in selected island nations. The sources of data for both tables can be found in Table 41.

Table 40 shows that the caries experience of WHP was low when compared to other South Pacific nations. It had the lowest mean DMFT value at age groups 8 and 11 years; the second lowest value at age groups 9 and 12 years; and the lower value of the 2 solitary comparisons at age groups $11\frac{1}{2}$ and $13\frac{1}{2}$ years. However, in the 6 years age group, WHP had the highest value of the data compared.

With the exception of Tuvalu, Niue and Vanuatu, all the other data for comparison was obtained in the 1960s and 1970s. For reasons mentioned previously, the caries experience of the nations concerned might have been expected to increase in the intervening years to the present. This only emphasises the generally low caries experience of WHP when

compared to other South Pacific island states.

Comparison of data regarding the percentage of caries free persons (Table 41) further confirms the above picture. With the exception of Tokelau (study conducted in 1964), WHP had the highest percentage of caries free persons for age groups ranging from 8 to 10 years. For age groups between 11 and 14 years, the picture is complicated by data from several nations where values for rural and urban populations showed large discrepancies. However, WHP still ranked among those nations with the least persons affected in these age groups.

The possible reasons for the differences in caries prevalence between the above nations have been put forward by several studies. These relate to differences in diet between urban and rural populations, sugar consumption, natural fluoride levels in water, and the concentration of fluoride in tooth enamel.

Baume (1973) in French Polynesia, found that rural populations, existing on traditional diets, had a significantly lower caries experience than those located in urban centres. The latter, he observed, had generally abandoned ethnic customs and dietary habits. He also found the fluoride content of the urban diet to be lower than that of the rural traditional diet. Speake (1980) related the high caries prevalence in French Polynesia and the Cook Islands to their high sugar consumption levels (46.8 and 46.2 kg per capita per annum). Tonga and the Gilbert Islands, the two nations with the lowest sugar consumption in the study, had much less caries than those with high consumption levels. The low caries experience in the

Gilbert Islands and Tuvalu was attributed to the high naturally occurring fluorides in water (Hollis, Malaki 1974). The authors also found that persons with fluorosis were much less affected by caries than those without fluorosis.

Speake, Cutress and Ball (1979) suggested that caries prevalence differences may be linked to enamel fluoride concentration levels and sugar consumption. They found that when environmental factors such as diet were similar, population groups with varying enamel fluoride concentration levels showed little differences in caries prevalence. However, when the dietary environment e.g. sugar consumption, differed greatly, so did the caries experience. This was seen in comparisons between nations with low enamel fluoride levels, as well as between those with high and low enamel fluoride levels. They concluded that the beneficial influence of fluoride in enamel on caries, when occurring in suboptimal levels, was outweighed by dietary differences.

Finally, early French explorers in Tahiti noted "the splendid appearance and condition of teeth which the people retained till old age", and until the turn of the century, caries was unknown among the South Pacific islanders (Masi 1973). However, this situation as evidenced by the high caries prevalence in French Polynesia and the Cook Islands, no longer applies. Also caries prevalence would appear to be on the increase. This is shown when results from earlier studies - McDowell (1953) in the Cook Islands; Cadell (1959) in Nauru; Sutton (1966) in the Gilbert Islands; Camress (1974) in Western Samoa - are compared with those of the same nations listed in Tables 40 and 41. Increasing caries prevalence was also noted in a more recent

study in Tonga (Powell, Cutress 1981). The above scenario has widespread implications with regard to dental disease in the South Pacific, including Papua New Guinea.

6.2.3.2 RESTORATIVE CARE

Comparison of DT/DMFT percentage values (Table 41) reveals that the great majority of South Pacific nations, like WHP, had high rates of untreated decay. The values generally ranged from 56 to 100% in the 11-14 years age groups and from 60-100% in the 8-10 years age groups. The one outstanding exception is the Cook Islands - 32% and 3% respectively.

Whilst assessing untreated decay rates among these nations, it is important to consider the difficulties faced by the different dental health services. These relate to factors such as disease incidence, operator-population ratios, population density, treatment facilities, transport and the distances between population groups in the country, training and expertise of personnel etc. Several of these factors are dependent on the financial resources of the nation.

Of data available (Table 41), WHP (1:33,000) had by far the least favourable operator-population ratio among those compared. The Cook Islands (1:900) with the most favourable ratio, also had the lowest DT/DMFT percentage value. For nations with unfavourable ratios, dental health services are often faced with conflict between providing services for adults as against providing services for children. Conflict also arises between providing adequate care for a few as against inadequate care for many. Finally, the main dental operators

in French Polynesia and Fiji are French trained dentists and dental officers respectively. This is compared to some nations e.g. Papua New Guinea where dental auxiliaries form the backbone of dental health services.

Table 40 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH
SELECTED SOUTH PACIFIC NATIONS

Nation	Mean DMFT	Nation	Mean DMFT
6 years		11 years	
WHP, Papua New Guinea	0.8 *	WHP, Papua New Guinea	1.2*
Tokelau	0.2	Cook Islands	6.0
Nauru	0.6	French Polynesia	5.1
Tuvalu	0.3	TTPI	3.7
Niue	0.4	Tonga	1.9
Vanuatu	0.4	Fiji	2.2
		Gilbert Islands	1.4
		Vanuatu	1.3
8 years		11½ years	
WHP, Papua New Guinea	0.5 *	WHP, Papua New Guinea	1.3 *
Cook Islands	2.7	New Caledonia	5.1
French Polynesia	2.4		
TTPI	1.9		
Tonga	1.2		
Fiji	1.2		
Gilbert Islands	0.7		
Tuvalu	1.0		
9 years		12 years	
WHP, Papua New Guinea	0.7 *	WHP, Papua New Guinea	1.4 *
Tokelau	0.3	Tokelau	0.3
Nauru	1.8	Nauru	3.2
Niue	1.6	French Polynesia	10.5
Vanuatu	0.9	Tuvalu	2.3
		Niue	2.6
		13½ years	
		WHP, Papua New Guinea	1.7 *
		Western Samoa - urban	5.2
		- rural	2.8

* Assumed mean DMFT values derived from Figure 12

Table 41 CRIES EXPERIENCE AND RESTORATIVE CARE - COMPARISON OF PERCENTAGE OF CRIES FREE PERSONS, % DT/DMFT AND OPERATOR-POPULATION RATIOS (WHP) WITH SELECTED SOUTH PACIFIC NATIONS

Nation	Age group (yrs)	% Caries free persons	% DT/DMFT	Operator - population ratio
1. WHP, Papua New Guinea	8-10 11-14	63 42	86 80	1:33,000
2. Tokelau	9 12	79 85	100 100	
3. Nauru	12	25	56	
4. New Caledonia	11-12	27	-	
5. Western Samoa - urban	13-14	11	88	
- rural	13-14	36	96	
6. Cook Islands	8 11	14 8	30 32	1:900
7. French Polynesia	8 11	0-44 0-59	71 73	1:3200
8. TTPI	8 11	13-62 7-50	84 73	1:1800
9. Tonga	8 11	39-58 27-50	92 84	1:4500
10. Fiji	8 11	47 22-30	83 68	1:7000
11. Gilbert Islands	8 11	61 49	100 86	1:17000
12. Tuvalu	8 12	46 30	60 35	
13. Vanuatu	9 12	60 54	78 69	

Sources of data for Tables 40 and 41:

Beck, Ludwig, Williams, Talagi (1964) - Tokelau

Yule (1968) - Nauru

Mura, Hollis (1974) - New Caledonia

Barnard, Woods, Cutress (1976) - Western Samoa

Speake, Cutress, Ball (1979); Speake (1980) - Cook Islands, French Polynesia, Trust Territories of Pacific Islands (TTPI), Tonga, Fiji, Gilbert Islands.

Barnes (1979) - French Polynesia (12 years age group)

Speake, Malaki (1982) - Tuvalu

Pulu (1984) - Niue

Bule (1986) - Vanuatu

6.2.3.3 PERIODONTAL STATUS

Comparison of periodontal status between WHP and other investigations will be limited to those which have utilised WHO recommended methods. However, this is still hampered by the lack of uniformity in assessment procedures. The present survey data was obtained using the CPIITN, where disease severity levels were diagnosed by probing. However, of the other investigations utilising previous WHO recommended criteria (WHO 1962; 1971; 1977), visual diagnosis and digital palpation were the main methods used for assessment. Probing in these earlier methods was only recommended when there were obvious signs of periodontal pockets.

Nevertheless, for the purposes of comparison, 90% of persons in the 11-14 years age group in WHP was diagnosed as being affected by calculus. For those studies involving a similar age group, and where no destructive periodontal disease was detected, the corresponding figures were as follows: Vanuatu - 12%; the Solomon Islands - 55% (Mura, Hollis 1974); Western Samoa - 67% (Barnard, Woods, Cutress 1976); and Tuvalu - 53% (Speake, Malaki 1982). From these figures, it would appear that calculus prevalence was highest in WHP. However, the figures for the other nations were most certainly an under-estimation of calculus presence due to the reasons stated above. Finally, Wong (1969) in Fiji, estimated that 5.4% of an 11-12 years age group sample suffered from periodontal pockets. For WHP, this figure was 0.4% in the 11-14 years age group.

6.2.3.4 OTHER CONDITIONS

Wong (1969) in Fiji estimated that 29% of persons between 5 and 19

years were affected by dentofacial anomalies, of which 21% required treatment. The corresponding findings for Western Samoa (Barnard et al 1976) in a 13-14 years age group sample were 26-46% and 17%. Baume (1973) reported that 4.6% of school children had gross anomalies and 29% had crowding in French Polynesia. 7% and 2% of anomalies were estimated to require treatment in Tonga and American Samoa respectively (Masi 1973). Relevant findings in WHP in terms of percentage of persons affected were: 40% dentofacial anomalies; 1.3% mesio-occlusion and disto-occlusion; and 24% crowding. Only 4.0% of persons affected by dentofacial anomalies were considered to require treatment. The above findings may suggest that the prevalence of gross abnormalities in WHP was lower than the other nations, and that its prevalence of crowding was similar to that of French Polynesia.

Fluorosis affecting some 50% of children had been reported in Tuvalu and Vanuatu (Mura, Hollis 1974) and the Gilbert Islands (Speake et al 1979). Although the "severe" form of the condition was not detected, the latter nation had generally more significant fluorosis than the others. Of the literature reviewed so far this section, no fluorosis had been found in French Polynesia, Fiji, Tonga, Trust Territories of Pacific Islands, the Cook Islands and the North Solomons. The prevalence of fluorosis in WHP, as indicated by the survey data, was low. Only 3% of persons sampled was affected by the "very mild" and "mild" forms of the condition. No "severe" fluorosis was found.

6.2.4 COMPARISON WITH CURRENT GLOBAL DENTAL DISEASE TRENDS AND PATTERNS

6.2.4.1 CARIES EXPERIENCE

Discussion will be focussed primarily on the caries experience at 12 years of age. This age, at which most global data has been collected, is considered to be of strategic importance in that it approximates to the end of primary schooling.

According to the WHO's classification on the severity of caries at 12 years (Sardo Infirri, Barmes 1979)¹, survey data indicates that the caries experience of WHP (mean DMFT 1.4) was low. Information collected in the WHO global oral health data bank (Barmes 1983b) suggests that the caries experience of WHP, when compared to developing nations, was higher than that of 13 nations, similar to that of 20, and lower than that of 45. It was lower than that of all 29 industrialised nations. This low caries experience is further confirmed when data at 8-9 and 13-14 years is compared to the results of a recently completed WHO study of industrialised nations (WHO 1985).

However, at 6 years, the caries experience of WHP can be considered "moderate" in that its mean DMFT value was located in the middle between the highest and lowest values of the nations compared. Tables 42-45 show the comparison of WHP's assumed DMFT values at the various ages with those of selected nations.

¹ Severity of caries at 12 years	
Level	Mean DMFT range
Very low	0.0 - 1.1
Low	1.2 - 2.6
Moderate	2.7 - 4.4
High	4.5 - 6.5
Very High	> 6.6

Caries experience in WHP at 12 years was also generally lower than that of nations located within the Western Pacific basin (Table 46). However, among those compared are nations (Hong Kong and Singapore), where increasing caries trends have been halted and significantly reversed (Renson 1984). Declining caries levels are also observed in traditionally high caries nations in the Western Pacific like Australia and New Zealand (FDI/WHO 1985). These favourable changes in caries patterns have been attributed to comprehensive programmes of oral health promotion, preventive programmes involving the use of fluoride in various forms and highly organised school dental services. Japan, on the other hand, has a high and stable caries prevalence. The strong environmental lobby in the country inhibits the use of fluorides in its many forms except topical application by dentists.

The implications of the above comparisons, with regard to WHP in particular, and Papua New Guinea in general, must be assessed in the context of global caries trends. A review of oral health status at 12 years (Renson 1984) indicated that the current trend is towards less caries in industrialised nations, and towards high levels in prevalence and severity in developing nations. The former are traditionally high caries nations with the reverse being true for the latter. New data from developing nations, particularly from urban centres, suggests that the caries experience of some is exceeding levels reported from some industrialised nations (Barmes, Sardo Infirri 1982). In 1982 (Barmes 1983b), the average DMFT for developing countries at 12 years, was estimated to be 1.8. When old data was removed, all of which most certainly underestimated the

present levels, the figure rose to 4.1. This is compared to the average DMFT value of 3.3 for industrialised nations in the same period. The significance of this can be seen where in 1970, developing nations had an average DMFT of less than 1 with several below 0.5. Such increases in this short time span are attributed to urbanisation and improved socio-economic conditions, both resulting in an unfavourable change in dietary patterns (Møller 1978).

Caries prevalence in industrialised nations, on the other hand, started decreasing from about 1950 to its present level (Renson 1984). Lower mean DMFT values are also in some cases accompanied by a drop in the percentage of persons affected by caries. These trends have been attributed to several reasons (FDI/WHO 1985). They refer to the general availability of fluoride viz water fluoridation, fluoride supplements (tablets and rinses) and the widespread use of fluoride dentrifices; the expansion and availability of dental resources in terms of favourable dentist-population ratios, school dental services, readily available dental care services etc; an increasing dental awareness leading to greater utilisation of dental services; organised oral health education programmes, and the adoption of a preventive approach by dental practitioners. Though still considered high, the fall in sugar consumption is also thought to be associated with declining caries.

Most developing nations attempt or have succeeded in imitating traditional Western style dental systems in their management of caries (Møller 1979; Cutress 1984). These costly systems, which adopt a restorative philosophy, require the services of highly qualified

personnel backed up by sophisticated technology. It is obvious from the above discussion that they have been unsuccessful in reducing caries levels in developing nations. Generally, the very nature of their populations (rural rather than urban); socio-economic conditions (poor rather than affluent); and disease conditions (endemic and untreated), indicate a need for a different approach to community care.

The need for an alternative approach to the management of caries is also highlighted by new evidence pointing to some deficiencies in a predominantly restorative approach. In vitro research has shown that caries is a dynamic process in which there are periods of remineralisation and demineralisation, and where caries progression is often uncertain (Silverstone 1983). Radiographic observations suggest that the majority of approximal lesions progress slowly, and large numbers remain unchanged for a long time (Pitts 1983). Investigations into the microbiology of both non carious and carious fissures, have resulted in the hypothesis that the ecosystem involving the bacterial composition in a "sticky" or questionable caries fissure may not be conducive to caries (Meiers, Wirthlin, Shklair 1982; Meiers, Jensen 1984). Elderton (1985) in a series of studies and literature reviews indicated a sizeable proportion of carious lesions do not progress if left alone; that there are wide variations in caries diagnoses leading to idiosyncratic treatment decisions by dentists; and that the durability of restorations is poor - a median survival period of $4\frac{1}{2}$ to 10 years. It has been reported that reparative dentistry, even when freely available, has failed to produce a high level of positive dental health in some industrialised nations (Valentine 1981).

Caries, it has been suggested, cannot be effectively controlled by restorative strategies unless they are accompanied by preventive measures (Ibikunle 1985).

Finally, caries prevalence levels indicate that prevention is succeeding in Western industrialised nations. Hence an alternative for developing countries to the restorative philosophy may be a more selective approach to restorative treatment, and a greater commitment to prevention in all its various forms.

Table 42 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH GLOBAL EPIDEMIOLOGY (DEVELOPING NATIONS) - 12 YEARS

Source	Nation	Date of study	Mean DMFT
	WHP	1983	1.4 *
Renson (1984)	Chile	1978	6.3
"	Ethiopia	1975	1.5
"	Iran	1976	4.9
"	Israel	1976	3.7
"	Jordan	1981	2.7
"	Kenya	1982	3.7
"	Lebanon	1974	3.6
"	Mexico	1976	5.3
"	Morocco	1980	4.5
"	Philippines	1981	2.9
"	Thailand	1982	4.4
"	Uganda	1982	1.5
"	Zaire	1982	2.3
FDI/WHO (1985)	Brazil	1980	7.2
"	Columbia	1980	4.8
"	Nigeria	1973	2.9
WHO (1984)	Burma	1982	0.8(rural) - 3.1(urban)
"	Cameroon	1982	1.4(rural) - 1.8(urban)
"	China	1981	0.6(rural) - 1.9(urban)
"	Oman	1978	0.7(rural) - 2.5(urban)
"	Saudi Arabia	1979	1.3(rural) - 2.2(urban)
"	Somalia	1979	0.3(rural) - 1.5(urban)
"	Sudan	1979	0.4(rural) - 1.4(urban)
"	United Arab Emirates	1981	1.2(rural) - 2.6(urban)
Sheiham (1974)	Indonesia	1973	1.4(rural) - 3.5(urban)

* assumed mean DMFT derived from Figure 12

Table 43 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH GLOBAL EPIDEMIOLOGY (INDUSTRIALISED NATIONS) - 12 YEARS

Source	Nation	Date of study	Mean DMFT
	WHP	1983	1.4 *
FDI/WHO (1985)	Denmark	1981	4.7
"	Finland	1982	4.1
"	France	1982	3.4
"	Ireland	1980	3.9
"	Japan	1980	5.9
"	Netherlands	1982	3.9
"	New Zealand	1983	3.3
"	Norway	1982	4.4
"	Sweden	1982	3.4
"	United Kingdom	1983	3.0
"	USA	1980	2.6
Renson (1984)	Switzerland	1980	1.7
Commonwealth Department of Health (1987)	Australia	1986	2.0
Nations between industrialised and developing status			
FDI/WHO (1985)	Hong Kong	1980	1.8
"	Singapore	1979	2.8

* Assumed mean DMFT dervied from Figure 12

Table 44 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH
GLOBAL EPIDEMIOLOGY (INDUSTRIALISED NATIONS) -
8-9 YEARS AND 13-14 YEARS

City/Nation	Mean DMFT (8-9 years)	Mean DMFT (13-14 years)
WHP	0.6*	1.7 *
Baltimore (USA)	0.8	2.7 - 3.3
Ontario (Canada)	1.6	4.0 - 5.0
Sydney (Australia)	2.3	6.0 - 7.2
Hannover (Federal Republic pf Germany)	3.3	8.4 - 9.2
Yamanashi (Japan)	2.7 - 3.1	7.5 - 7.5
Canterbury (New Zealand)	3.2 - 3.3	10.3 - 11.2
Dublin (Ireland)	1.3	4.2 - 4.6
Trondelag (Norway)	4.0 - 4.1	12.6
Leipzig (German Democratic Republic)	1.4 - 1.7	4.3 - 5.3
Lodz (Poland)	2.6 - 2.7	6.8 - 7.9

* Assumed mean DMFT values from Figure 12
0.6 represents 8½ years
1.7 represents 13½ years

Source: WHO (1985)
Oral health care systems - An international collaborative
study
London: Quintessence

Table 45 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH GLOBAL EPIDEMIOLOGY (INDUSTRIALISED & DEVELOPING NATIONS) - 6 YEARS

Source	Nation	Date of study	Mean DMFT
	WHP	1983	0.8*
Industrialised nations			
FDI/WHP (1985)	Finland	1982	0.3
"	France	1975	0.3
"	Ireland	1980	2.5
"	Japan	1980	0.6
"	Netherlands	1978	3.8
"	New Zealand	1981	2.9
"	Norway	1977	0.2
"	United Kingdom	1983	2.0
"	USA	1980	0.2
Commonwealth Department of Health (1987)	Australia	1985	0.1
Nations between industrialised and developing status			
FDI/WHO (1985)	Hong Kong	1968	0.3
"	Malaysia	1971	0.8
"	Singapore	1979	0.4
Developing nations			
FDI/WHO (1985)	Brazil	1980	1.6
"	Columbia	1980	0.4
"	Thailand	1977	0.7

* Assumed mean DMFT - see section 6.2.1

Table 46 CRIES EXPERIENCE - COMPARISON OF MEAN DMFT (WHP) WITH
WESTERN PACIFIC NATIONS - 12 YEARS

Source	Nation	Date of study	Mean DMFT
	WHP	1983	1.4*
Commonwealth Department of Health (1987)	Australia	1986	2.0
FDI/WHO (1985)	Hong Kong	1980	1.8
"	Japan	1980	5.9
"	New Zealand	1983	3.3
"	Singapore	1979	2.8
"	China	1981	0.6(rural)-1.9 (urban)
Renson (1984)	Philippines	1981	2.9
"	Thailand	1982	4.4
Sheiham (1974)	Indonesia	1973	1.4(rural)-3.5 (urban)

* Assumed mean DMFT derived from Figure 12

6.2.4.2 PERIODONTAL STATUS

Comparison of the survey results with current global trends will refer to studies whose data was obtained using the CPITN.

The percentage of persons and the mean numbers of sextants affected by gingival bleeding and calculus for those between 11-14 years (WHP) were 99% and 4.1, and 90% and 2.7 respectively. According to the classification on periodontal disease prevalence and severity for persons at 15 years (WHO 1980b)¹, these findings indicate that the periodontal health of WHP was poor, when compared to global trends.

The results of a WHO study (Barnes, Leous 1986) of 12 and 13 year olds, in industrialised and developing nations, are listed in Table 47. When compared to WHP's data for the 11-14 year age group (midpoint 12½ years), it can be seen that WHP had a lower recording for mean number of healthy sextants, and a higher calculus prevalence than industrialised nations. Similar comparisons with developing nations reveal that the corresponding recordings are located between the highest and lowest scores for these nations. WHP's poorer periodontal status in relation to industrialised nations is further illustrated when its data on the 11-14 years age group is compared with the latter's data for 15-19 years (Table 48).

¹ Calculus/Gingival bleeding prevalence

		Low	Moderate	High
Calculus	% persons affected	0-50	51-80	81-100
	Mean number of Sextants affected per person	0-1.5	1.6-2.5	> 2.6
Gingival bleeding	% persons affected	0-20	21-50	51-100
	Mean number of sextants affected per person	0-0.5	0.6-1.5	> 1.6

Finally, Table 49 allows comparison on the prevalence of periodontal treatment needs. It is evident from the table that treatment needs in terms of oral hygiene instruction and prophylaxis in developing nations are high. It is also apparent that in such nations, including WHP, generalised marginal gingivitis exists commonly in association with calculus.

It would appear from the above tables that periodontal status in developing countries is poor. This is mainly attributed to the neglect of oral hygiene. However, current global trends indicate that the traditionally poor periodontal status in industrialised nations is improving. It is suggested that this is due to marked improvements in oral hygiene and the adoption of systematic mouth cleaning habits.

Of significance to the unfavourable periodontal disease situation in developing nations is new research evidence which has led to a fundamental reappraisal of the pathogenesis of chronic periodontal disease (Renson 1984). Prior to these findings, the assumption is that periodontal disease inevitably progresses from marginal inflammation to periodontal breakdown, leading to loss of bony support, and the eventual loss of teeth. However, it is now being suggested that chronic marginal inflammation may or may not lead to loss of alveolar support. If periodontitis does result, it may manifest as a "contained" or a progressive form. It is estimated that 10-15% of people may be at high risk to the progressive form of the disease. Recent evidence also suggests that the reasons for tooth loss are complex, and that periodontal disease is not a major factor responsible for it (Sheiham 1984). Hence, despite the endemic levels

of gingivitis and shallow pocketing in developing nations, the implications of the above are clear. Since chronic marginal inflammation is plaque associated, improved oral hygiene may be the main response that is required to control the disease. This is opposed to treatment by professional intervention with all its inherent costs and resource implications.

Finally, the CPITN is primarily designed for the assessment of periodontal treatment needs in a population (Ainamo et al 1982). It can also be used, indirectly by extrapolation, to estimate the resources required to meet such needs in terms of time units and personnel (WHO 1978b). Treatment strategy is based on a one to one operator-patient mode. No account is made of the role of community and group education programmes in controlling the disease. However, studies in Brazil (Gjerme, Bellini, Marcos 1983) and Kenya (Manji, Sheiham 1986) have reported that the CPITN tends to overestimate treatment needs in young populations where bone loss is usually uncommon. These studies further stated that treatment estimates calculated from using the index, are quite out of proportion to the public health significance of periodontal disease in these populations. Supporting these findings are observations in Sudan (Barmes 1979), where a young population with high calculus levels also had extremely healthy supporting tissues. Further, although the CPITN data from developing nations shows a higher prevalence of gingival bleeding and calculus than industrialised nations, it is not associated with pocketing prevalence at earlier ages (Barmes 1984).

Hence, together with the changing concepts of periodontal disease, it would appear that developing nations will benefit most by directing their scarce resources towards organised health education programmes to promote and improve the practice of oral hygiene, and provide treatment to those most in need.

Table 47 COMPARISON OF MEAN NUMBER OF AFFECTED SEXTANTS (CPITN) -
WHP (11-14 YEARS) WITH GLOBAL EPIDEMIOLOGY (12 and 13
YEARS

Nation	Age (yrs)	Mean number of sextants				
		Healthy	Bleeding	Calculus	4-5mm pockets	6+mm pockets
WHP	11-14	1.9	4.1	2.7	0.0	0.0
Industrialised nations						
Czechoslovakia	12	3.5	2.5	2.0	0.0	0.0
Finland	13	4.1	1.9	1.2	0.0	0.0
German Democratic Republic	13	3.1	2.9	1.7	0.0	0.0
Japan	12	3.9	2.1	1.5	0.0	0.0
Lithuania	12	2.2	3.8	2.1	0.0	0.0
Norway	12	4.3	1.7	0.6	0.0	0.0
Sweden	12	3.5	2.5	1.5	0.0	0.0
Yugoslavia	12	2.1	3.9	2.8	0.0	0.0
Developing nations						
Afghanistan	12	1.5	4.5	2.4	0.0	0.0
Bangladesh	12	1.2	4.8	3.2	0.15	0.0
Cuba	12	2.8	3.2	2.6	0.0	0.0
Jordan	12	1.9	4.1	3.4	0.0	0.0
SPLAJ	12	1.9	4.1	3.1	0.1	0.0
Syria	12	1.1	4.9	3.9	0.0	0.0
Thailand	12	0.9	5.1	3.8	0.1	0.0
Yemen PDR	12	3.2	2.8	2.2	0.02	0.0

Source: Barmes, Leous 1986
Assessment of periodontal status by CPITN and its
applicability to the development of long term goals on
periodontal health of the population
Int Dent J 36: 177-181.

Table 48 COMPARISON OF MEAN NUMBER OF AFFECTED SEXTANTS (CPITN) -
WHP (11-14 YEARS) WITH GLOBAL EPIDEMIOLOGY (15-19 YEARS)

Nation	Mean number of sextants		
	Healthy	Bleeding	Calculus
WHP	1.9	4.1	2.7
Industrialised nations			
Australia (1)	5.1	0.9	0.8
Australia (2)	4.8	1.2	0.6
Finland	1.3	4.7	0.8
France	4.1	1.9	1.1
Italy	2.4	3.6	2.6
New Zealand	4.8	1.2	0.3
Sweden	4.0	2.0	0.8
Yugoslavia	1.7	4.3	3.5
Developing nations			
Bangladesh	1.1	4.9	3.4
China	3.3	2.7	2.6
Cuba	1.5	4.5	4.2
Ethiopia	1.7	4.3	1.2
EMRO	2.1	3.9	3.4
Fiji	1.7	4.3	3.9
Korea	0.8	5.2	3.6
Libya	1.2	4.8	3.8
Malawi	4.5	1.5	1.4
Morocco	3.0	3.0	1.9
Nepal	4.5	1.5	0.8
Nigeria (1)	1.1	4.9	4.0
Nigeria (2)	0.3	5.7	4.8
Niue	2.0	4.0	1.7
Papua New Guinea	0.3	5.7	5.0
Philippines	2.7	3.3	2.7
Syria	3.3	2.7	1.6
Thailand	0.0	6.0	5.5
Tonga	1.1	4.9	3.7
Western Samoa	0.4	5.6	4.4
Yemen PDR	1.8	4.2	3.8

Source: Cutress 1986
Periodontal health and periodontal disease in young people:
global epidemiology
Int Dent J 36: 146-152.

Table 49 COMPARISON OF PREVALENCE OF PERIODONTAL TREATMENT NEEDS
(CPITN) - WHP WITH GLOBAL EPIDEMIOLOGY (12 YEARS)

Nation	TN 1	TN 2	TN 3
	(%) Oral hygiene instruction	% (mean number of sextants) Oral hygiene instruction and prophylaxis	% (mean number of sextants) Complex care
WHP *	99	90 (2.7)	0
Bangladesh	95	89 (3.3)	0
Ethiopia	94	71 (1.3)	0
Finland	100	30 (0.4)	0
Israel	73	10 (0.1)	0
Italy	96	88 (2.2)	0
Jamaica	99	91 (3.1)	25 (0.4)
Libya	92	87 (3.1)	0
Morocco	97	63 (1.4)	0
Nigeria	91	76 (3.3)	0
Portugal	33	27 (0.5)	0
Sri Lanka	87	79 (2.6)	0
USSR	88	70 (2.2)	0
Vanuatu	68	51 (1.5)	0
Vietnam	100	88 (3.2)	0

* Values for 11-14 years age group

Source: Cutress 1986
 Periodontal health and periodontal disease in young people:
 global epidemiology
 Int Dent J 36: 146-152.

6.2.4.3 OTHER CONDITIONS

Comparison of dental conditions, apart from caries and periodontal disease, is severely restricted due to the scarcity of published literature; and the lack of pertinent information lodged with the WHO global oral health data bank (Barmes 1988).

Dentofacial anomalies

In a WHO study of 12 European cities of children between 13 to 14 years (WHO 1985), the following were observed: crowding affected 9.9 to 48.9% of persons examined; spacing 5.6 to 51.3% and occlusal anomalies involving the dental arch relationship 36.3 to 61.7%. The corresponding measurements in WHP were 24%, 7% and 3.7%.

Oral mucosal lesions

Of conditions relevant to the survey, a Swedish study of persons 15 years and above (Andreasen, Pindborg, Hjörting-Hansen, Axéll 1986) reported the prevalence of the following conditions: recurrent aphthae 17.7%; leukoplakia 3.6%; cheek and lip biting 5.1%; and traumatic ulcers 4.3%. Corresponding recordings for WHP were 0.3%, 0.4%, 11.8% and 0.5%.

The same study also stated that oral leukoplakia has long been recognised as a frequent precursor to oral cancer. There exists a significant relationship between various oral habits such as smoking, betel chewing and the use of snuff with the former condition. Estimates suggest that there is a risk factor of 6% of oral leukoplakias developing into carcinomas. With betel chewing more prevalent in the highlands region, the implication is that the

frequency of oral leukoplakia in WHP is likely to increase.

Developmental defects of enamel

Developmental defects of enamel are very common. Cutress and Suckling (1982) reported that 1 in every 3 individuals had one or more teeth with an obvious non carious defect. The most common manifestations were opacities, enamel hypoplasia and discoloured enamel. A recent study in New Zealand (Suckling, Brown, Herbison 1985) suggests that 57% of 9 year olds examined were affected. However, treatment needs were low. Only 1% of the children were deemed to require treatment, mainly for aesthetic reasons. In WHP, similarly low treatment needs were recorded - 0.5% of the total sample. Of the 86% of persons affected by enamel hypoplasia and opacities in the survey, 85% were judged to be free from fluorosis.

Pindborg (1982), in a review of literature on enamel defects not related to fluorosis, reported that the lesions are a sequelae of systemic, traumatic or genetic events during tooth development. Although almost 100 factors have been held responsible for inducing tooth defects, there is difficulty in allocating most observed lesions to a specific cause. Many of the aetiological factors are uncommon systemic or inherited conditions in which tooth defects are but part of a syndrome.

Traumatic dental injuries

Traumatic injuries are very frequent (Andreasen et al 1986). The authors, with reference to a study involving mainly industrialised nations reported that the prevalence of injuries ranged from 15 to 28%

in children aged 3 to 6 years. The predominant feature is crown fracture with or without pulpal involvement. According to survey data 10.9% of the children in WHP were affected by the latter condition.

6.3 SURVEY DATA AND IMPLICATIONS FOR THE PROVISION OF DENTAL CARE SERVICES

Survey data has indicated that while caries experience was low, periodontal disease prevalence and severity in terms of gingival bleeding and calculus was high. Although the rates of occurrence of other dental conditions assessed varied, their treatment needs would appear to be negligible. A significant finding was the large amount of untreated decay present. There was minimal restorative care in the primary dentition. For the permanent dentition, there was one tooth extracted for every 2.3 teeth restored. Such findings strongly suggested that dental health services were not coping with the dental needs of the school population.

Current global trends indicate that caries levels are increasing in developing countries. Although it is difficult to predict what the future dental disease patterns will be in the province, a rise in caries experience is likely. This could be the result of increasing urbanisation, and the associated increased consumption of foods containing refined carbohydrates. The endemic levels of periodontal disease would appear consistent with those of developing countries. This will remain so until the population becomes aware that good oral hygiene is synonymous with good periodontal health.

Demand for dental services, while low among adults at present, will probably increase. Factors likely to cause this are the rapidly expanding population, urbanisation, and greater dental awareness due to improved education levels. Increased demand will result in further conflict between providing services for adults as against those for

children; and providing adequate care for a few and inadequate care for many.

With the economic constraints of a developing country, and a low priority status, the provincial dental health service is unlikely to receive large increases in resource allocation. Staff shortages, antiquated dental equipment, and access and transport difficulties related to isolated population groups, are major problems confronting the service. Together with the extremely low dental workforce production at the national level, and its inappropriate training for the needs of the wider community (Dissanayake 1985), how then is the service to cope with the present or indeed the future dental disease situation in the province?

6.3.1 DENTAL PROGRAMMES

Given the above constraints, dental programmes must be oriented towards prevention and control rather than curative, restorative and rehabilitative functions. They should be devoted to changes of behaviour consistent with good oral health, and which emphasize community involvement at the primary care level. It is important that the planning and development of strategies for the delivery of services take into account costs and available resources. There should be appropriate training of dental personnel related to needs. Non dental personnel could be trained to provide dental clinical services where feasible, and be involved in dental health promotion and education. The use of less complex and more affordable methodology, technology and equipment is paramount. The development of measurable goals is critical for the monitoring and systematic

evaluation of programme activities.

6.3.1.1 PREVENTION

6.3.1.1.1 CARIES

Use of fluoride

The use of fluoride is recognised as the most effective means available for caries prevention in community based programmes. Of the methods available, water fluoridation is the most efficacious and cost effective in reducing prevalence and severity levels (FDI 1984). The method benefits both children and adults, the latter through topical action. In areas of low but increasing caries prevalence, the effect of water fluoridation may not be a reduction in the caries level, but only a halt in the rate of increase, or a levelling off of the upward trend (WHO 1984). Water fluoridation requires the existence of public water systems, adequate technology, and the maintenance and monitoring of plant.

With a low caries experience in the province, and with only one urban centre (population 15000) with limited public water supply, water fluoridation may not be an appropriate prevention measure at present. However, it is possible that feasibility studies for its application could be conducted to ascertain costs, benefits, natural fluoride levels etc should caries prevalence increase dramatically in the future.

Another cost effective method is supervised fluoride mouth rinsing in schools. Evidence suggests that this method can achieve up to 35% reduction in caries levels if used daily, weekly or fortnightly

(Horowitz 1982). It is an easy technique for children to learn; inexpensive; and enables the use of non dental personnel where only minimal supervision is necessary. Little time is required (estimated fortnightly rinsing 10 minutes per group of 30); and there is good acceptance by participants.

The above method, based on simple technology and resources at the community level, would appear ideal for the province. Non dental staff such as aid post orderlies, other health staff, teachers, as well as non clinical dental staff could all be involved in the operation of the programme. Hence, a caries prevention programme involving supervised fortnightly rinsing with 2g/l sodium fluoride, is recommended, especially for urban schools where caries prevalence is likely to increase.

Of other community based fluoride prevention methods (WHO 1984), salt fluoridation is cheap, and is suitable in places with no public water system. However its application would require legislative action. Supervised daily consumption of fluoride tablets in schools is very effective in reducing caries. The problem with this method is that it requires constant supervision for optimum effectiveness, and with it, the associated problems with compliance.

Studies have suggested that the unsupervised home use of fluoridated toothpaste by both adults and children is as effective as twice annual professionally applied treatments with acidulated phosphate fluoride gel (FDI/WHO 1985). It is regarded as a significant reason for declining caries in Western nations. In Western Highlands Province,

promoting the use of this method is difficult owing to the lack of mouth cleaning habits, and the general unavailability of toothpastes and toothbrushes in most areas. However, education programmes are indicated in urban areas where people are more likely to be dentally aware, and where oral hygiene implements are more readily accessible. Efforts could also be made to encourage rural trade store owners to stock these items. These measures should be complimented with educational activities in rural communities. It is possible for investigations to be made on the costs, feasibility and desirability of providing oral hygiene implements to schools. Where toothbrushes are unavailable, their substitution by local materials should be encouraged.

Finally, other fluoride prevention methods such as professional application of topical fluorides; school water fluoridation; supervised brushing with fluoride gels, solutions and pastes are expensive (Burt 1982). They are regarded as impractical in the given circumstances.

Fissure sealing

This expensive measure, which requires a meticulous and thorough application technique, is regarded as unsuitable for general use. However, it may be indicated for those children at high risk to caries, and in population groups where pit and fissure caries are predominant.

Control of cariogenic diet

Evidence suggested that the prevalence and incidence of caries is high

if a high proportion of total energy intake comes from foods containing a great deal of sugar (WHO 1984). Much of the sugar consumed in modern day diets is "hidden" sugar found in processed foods. For the province, and Papua New Guinea in general, the move towards economic development has resulted in dietary changes unfavourable to dental health. Urban populations nowadays rely heavily on Western foods containing refined carbohydrates. Changing dietary patterns are also seen in rural areas due to the establishment of trade stores.

Education programmes with regard to a dentally healthy diet must be designed to increase knowledge and reinforce desired behaviour patterns. Utilising both dental and non dental personnel, dental health education should be directed at target groups in order to concentrate resources, and to allow for specificity of information provided. Such groups could include parents, teachers, expectant mothers, school children and health care providers. It is recommended that oral health education be built into general health education programmes e.g. those involving nutrition, and maternal and child health activities. Dental health information aids should be developed. Promotional efforts could also include the use of mass media such as newspapers and radio networks.

It is important that local people are involved during the planning stages of educational and promotional programmes. This will enhance appropriate intervention, and the practicality and acceptability of activities. In this manner, ready acceptance of programme activities is ensured. This will facilitate the better use of resources.

Finally, the monitoring of sugar consumption levels at the national level is important to allow timely intervention when necessary. Intervention may involve lobbying higher authorities to support measures designed to reduce consumption. Such measures could include the regulation of advertising; the labelling of sugar content in processed foods; and the import from overseas of processed foods with reduced sugar content or those in which sugar substitutes are used. These actions would move dietary control into the community level rather than seeking life style change in individuals.

6.3.1.1.2 PERIODONTAL DISEASE

There are some fundamental distinctions between the approach to controlling caries and the philosophy of controlling periodontal disease at the community level. Simple and effective procedures analagous to the various uses of fluorides for caries procedures do not exist for periodontal disease (Burt 1982). Given the endemic levels of periodontal disease, primary prevention at the community level is an unrealistic goal. Control, implying the necessity to accept certain levels of the disease which are low enough not to interfere with function, is probably more achievable. For public health programmes, the dental operator-patient approach in controlling the disease is largely ineffective. Education programmes aimed at reducing the dental plaque level of the community are less costly and more effective.

Prevention of periodontal disease depends on individual action, where evidence suggests thorough mouth cleaning at 24 hour intervals to be the best regimen (FDI 1984). No significant difference has been

observed between toothbrushing methods in their ability to remove plaque. As with the promotion in the use of fluoridated toothpaste in caries prevention, there is inherent difficulty in controlling periodontal disease in a population with no traditional or cultural concept of mouth cleaning. Also there is some evidence to suggest that the benefits of public education aimed at changing individual behaviour appear limited (FDI/WHO 1985). Among the reasons for these limited benefits could be the inappropriate choice of methods and recipient age groups. Hence the effectiveness and cost effectiveness of education programmes will remain uncertain for some time.

Despite the above and until more effective means of improving oral hygiene status at the public level are developed, education programmes are at present the only feasible means for controlling the disease in the province. The objective of dental health education should be to increase knowledge and awareness so that mouth cleaning is seen as part of general hygiene. Oral hygiene education should be incorporated in health education directed at improving body hygiene and grooming.

It is suggested that control of the disease encompass all the approaches similar to those for the control of cariogenic diets. Community participation is important in the planning and implementation of programme activities. Education of community leaders will facilitate the process by which they can act as role models in correct health behaviour. Promotion of good oral hygiene in schools will be enhanced by efforts made to improve general hygiene. There should be professional education to improve tooth cleaning

instruction by dental personnel. Teachers, parents, primary health care workers etc could be provided with specific oral health education so that they will provide accurate information and set good examples.

Finally, an important factor which mitigates against achieving better oral health status in the population is the very nature of common dental disease (Davis 1980). Regular toothbrushing may not produce a reduction in caries experience. Although effective toothbrushing may prevent periodontal disease, the chronic nature of this condition dictates that symptoms may take a long time to develop. The negative consequences of an "incorrect" diet may only become apparent in the long term. Hence efforts directed toward producing changes in attitude and behaviour may only be partially successful. These efforts should always be complimented with disease prevention methods that require minimal individual initiative such as community water fluoridation, supervised school based preventive programmes, legislation to reduce consumption levels etc.

6.3.1.2 CLINICAL SERVICES

The range of clinical services provided must be appropriate to the needs and resources available. Priorities will out of necessity include treatment for relief of pain, trauma and conditions endangering life and well being. Given national health guidelines, programmes are to emphasise the early detection and treatment of dental disease in children and adolescents. There should be minimal provision of sophisticated treatment such as those requiring complex and expensive care. Since survey data has indicated that the prevalence of gross dentofacial anomalies was very low, orthodontic

care for children is not considered a treatment priority.

6.3.1.2.1 CRIES

Caries management tends to be the major consumer of dental personnel whether caries prevalence is high or low, increasing or decreasing, or stable (FDI/WHO 1985). Previous discussion has highlighted the inadequacies and the inappropriateness of a predominantly restorative approach in developing nations. Hence, a balance must be found between meeting existing treatment needs and prevention; providing adult and child dental services; and providing services for urban and rural populations.

With the constraints facing the provincial dental health services, priority should be focussed on the provision of primary school dental services. It may be necessary for treatment preference to be given to the permanent dentition over the primary dentition. Ideally, services should be accessible and equitable to all schools in the province. However, survey data has indicated that the caries prevalence of the primary dentition is higher in areas with better access and higher altitude. Also previous epidemiological studies in Papua New Guinea revealed similar findings for the permanent dentition. Hence in an acute resource shortage situation, it is suggested that consideration be given to concentrate resources in urban and high altitude schools.

Resources permitting, routine treatment programmes could also be planned for the 9 provincial high schools. Adult services would be provided on demand in the main and rural dental clinics, as well as on visits to rural communities.

Prolonged fluoride application

There is evidence to suggest that a minimal treatment programme involving the "prolonged topical fluoride application method - PFA" (Craig 1981) may be of enormous benefit to the provincial dental situation. A two stage treatment programme (silver fluoride followed by stannous fluoride) has been found to be highly effective in limiting caries progression in primary molars (Craig, Powell, Cooper 1981). When treated with stannous fluoride, a significant proportion of susceptible fissures in permanent molars remains free of carious lesions after several years (Craig, Powell 1979). It is suggested by the latter study, that such treatment is effective in increasing the caries resistance of sound fissures as well as slowing or arresting the development of incipient lesions. In addition, PFA treatment, in terms of cost benefits and cost effectiveness, is economically more viable than the placement of fissure sealants or amalgam restorations (Enno, Craig 1982).

In a situation where dental resources are limited, and where there is a large backlog of unmet needs, the advantages of the above treatment methods are obvious. In the case of primary teeth, the slowing or arresting of carious lesion growth would obviate the need for reparative treatment prior to exfoliation. Priority can hence be given to the restoration of larger cavities with little risk of the remaining lesions developing too rapidly. For the permanent dentition, PFA may be used to treat susceptible sites of partially or newly erupted teeth. Permanent teeth are most susceptible to dental decay in the first four years after eruption (Craig, Powell 1979). Thus, PFA treatment would increase caries resistance of such teeth

over a period of high caries susceptibility, or at the very least, delay the onset of caries.

Utilisation of primary health care workers

Finally, it is strongly recommended that non dental health personnel especially the aid post orderly be utilised in the provision of dental clinical services. They could be trained in procedures involving simple techniques. The current provincial programme of training such personnel in tooth extractions should be maintained. Also it would be possible to include in their training additional skills such as the PFA treatment method and the placement of temporary dressings. The advantages of such a training programme are the significant increase in workforce numbers in relation to dental care providers; the provision of dental pain relief in remote and inaccessible areas; the provision of an appropriate and preventive service in terms of PFA treatment; and the potential dental health promotion benefits derived from the involvement of non dental personnel in dental care.

6.3.1.2.2 PERIODONTAL DISEASE

The principal therapeutic strategy for controlling periodontal disease is to reduce the amount of dental plaque. Current evidence precludes calculus as a primary aetiological factor in disease progress (Cutress 1986). However, its removal, especially the subgingival form, is considered essential if plaque control is to be achieved. Given the high prevalence of calculus as indicated by the data, calculus removal for all appears formidable.

The WHO (1984) has reported that public health programmes of regular

plaque removal in children may be of doubtful cost effectiveness. It has also been suggested that current treatment strategies used by dental operators e.g. plaque control, scaling and root planing share a major shortcoming (Sheiham 1984). It is the failure to recognise that the methods are more appropriate to treating acute disease which requires a high rate of short term compliance. Long term health behaviour change is required for controlling a chronic disease like periodontal disease. In addition, the changing concepts in the pathogenesis of the disease has resulted in the estimation that only about 10 to 15% of people are susceptible to the destructive form of the disease. Hence given the above factors, it is recommended that the main emphasis for controlling periodontal disease should be the promotion of good oral hygiene complimented by treatment for those most in need.

Primary care workers like the aid post orderly could be trained in providing oral hygiene instruction, and plaque and calculus removal. Treatment for adults could be provided on demand. School treatment programmes, staffed by such workers, could be instituted for older children i.e. those between 11-14 years and high school children. With the low numbers of dental personnel, it is suggested that their role be mainly limited to educational, promotional and supervisory aspects in the control of the disease.

6.3.2 DENTAL WORKFORCE REQUIREMENTS

Dental workforce requirements are based on factors such as dental disease status; the types of programmes to be implemented; programme goals and objectives; the range of services to be provided; and the

role and type of personnel (dental and non dental) providing services. In the province, the provincial dental officer assumes primarily managerial functions whilst most of the services are provided by dental therapists. Hence it is pertinent to first estimate dental therapist workforce requirements based on survey data for school dental services, and other dental statistical data for adult services.

6.3.2.1 DENTAL THERAPIST

The estimation of workforce requirement will be for the year 1987. This is based on primary school population projections in 1986, and on the adult demand for dental services in the period 1982-1986. In arriving at such estimations, it is assumed that there has been no change in dental disease prevalence and severity since the survey was conducted in 1983; that there is no dramatic increase in demand for services by adults; that there are equal numbers of persons in each primary school year; and that a child goes through 6 years (6 grades) of primary school.

Table 50 gives the estimated time allotments for various dental treatment categories. Using these time allotments, it is estimated that the annual workforce requirement for adult services on current trends is approximately 1.76 operator years (Table 51). The selected treatment categories in the table represent the great bulk of services provided by dental therapists for adults.

For school dental services, survey data and the above time allotments have enabled the estimation of treatment time for the backlog of unmet

needs (Table 52), and for the annual dental disease increment (Table 53). From the information in these two tables, it was then possible to estimate the workforce requirement for an incremental school dental service based on a 12 month recall period. Table 54 presents these workforce estimates of different types of school dental care related to the range of services provided i.e. Type 1 - Type 6. The method for calculating workforce requirements for school dental services can be found in an example (Type 6) in Table 55.

From Table 54, it can be seen that the number of operator years required for the first year of incremental school dental care (backlog and one annual dental disease increment), vary from 10.53 (Type 6) to 19.84 (Type 1). Corresponding workforce requirements for annual maintenance care (one annual disease increment) are 2.85 (Type 6) to 8.63 (Type 1) operator years. Western Highlands Province has a compliment of 7 dental therapists in 1986. Together with the 1.76 dental therapist operator years required for adult services, it can be seen that moderate to large increases in workforce numbers are necessary for the treatment of the backlog of unmet needs. However, given the current low national production of dental therapists, only minimal increases are envisaged in the near to interim future.

The type 1, 2 and 3 modes of care are considered inappropriate since they exclude primary health care workers from providing dental clinical services. The adoption of types 5 and 6 would mean a much reduced role for dental therapists in dental health education. However, given the present constraints, type 6 would be most realistic. The temporary addition for a year of 5 dental therapists

into the province would be required for the first year of the proposed incremental care programme. After this year, annual maintenance care could then be provided on the basis of type 4. This approach would enable the provision of dental health education, and dental clinical services such as plaque and calculus removal, prolonged fluoride application treatment etc by aid post orderlies. Finally, if only modest or no increases in workforce numbers could be forthcoming, the provision of annual care based on type 4 (which includes the treatment of annual disease increment and some disease backlog) would appear feasible for approximately 50% of the total primary school population.

Table 50 TIME ALLOTMENTS - DENTAL TREATMENT CATEGORIES

Source	Dental Treatment Category	Time allotment (minutes)
Barmes (1983c)	Examination	7
"	Dental health education session	10
"	Prophylaxis	10
"	1 surface restoration	20
"	2 surface restoration	24
"	3 surface restoration	24
"	Extraction	7
Craig (1988)	Prolonged fluoride application (PFA) for caries arrestment - 2 applications of Ag/SnF ₂ per tooth per year	4
WHO (1978b)	Scaling (calculus or shallow pockets) per sextant	6.7
	Other	0.1

NB

1. The number of hours of patient care per operator per year is estimated to be 1500 hours (Barmes 1983c)
2. Scaling time allotment is derived by modifying WHO (1978b) estimate of 10 minutes per quadrant

Method: Quadrant times were multiplied by four to obtain full mouth times, then divided by six to give equivalent sextant times.

3. "Other" represents treatment needs not covered by the other treatment categories. e.g. treatment for oral mucosal conditions, tooth defects and abnormalities etc. An arbitrary 0.1 minute time allotment is given to this category due to the minimal treatment requirements recorded in this survey.

Table 51 WESTERN HIGHLANDS PROVINCE - ESTIMATED ANNUAL DENTAL THERAPIST WORKFORCE REQUIREMENTS - GENERAL DENTAL SERVICES

Treatment Category	Average number per year (9 operators)	Number per operator	Number for 7 operators	Treatment time allotments (mins)	Total treatment time (mins) - 7 operators
Examination	11752	1306	9140	7	63980
Prophylaxis	447	50	350	10	3500
1 surface restoration	2211	246	1720	20	34400
2 surface restoration	619	69	483	24	11592
3 surface restoration	266	30	210	24	5040
Extraction	7313	813	5691	7	39837
Total					158349

Number of dental therapists required for general dental services

$$= \frac{158349}{1500 \times 60}$$

$$= 1.76 \text{ operator years}$$

NB

1. "Average number per year" is the average for treatment category between 1982-1986.
2. 9 dental operators based in Western Highlands Province in the period 1982-1986: 1 provincial dental officer, 1 resident dental officer and 7 dental therapists.
3. Source for (1) and (2) - Dental health Services (1987).

Table 52 SURVEY DATA - UNMET NEEDS (BACKLOG) AND TREATMENT TIME

Type of treatment	Time allotment (mins)	Number of treatments per person	Treatment time per person (mins)
1 surface restoration	20	0.62	12.40
2 surface restoration	24	0.18	4.32
3 surface restoration	24	0.08	1.92
Extraction (permanent teeth)	7	0.18	1.26
Extraction (primary teeth)	7	0.02	0.14
PFA (primary teeth)	4	0.36	1.44
Scaling per sextant	6.7	2.03	13.60
Other			0.10
Total			35.18

NB

1. Extraction estimates for both permanent and primary teeth include those for caries and other reasons.
2. PFA estimates based on the difference between total number of decayed primary teeth and those indicated for extraction in the 6-7 and 8-10 years age groups.
3. Scaling estimates based only on number of sextants affected by calculus in the 11-14 year age group.
4. "Other" represents estimates not covered by the other treatment types.

Table 53 SURVEY DATA - ANNUAL DENTAL DISEASE INCREMENTS AND TREATMENT TIME

Type of treatment	Time allotment (mins)	Number of treatments per person	Treatment time per person (mins)
Decayed teeth (D):			
1 surface restoration	20	0.62	12.40
2 surface restoration	24	0.18	4.32
3 surface restoration	24	0.08	1.92
Teeth indicated for extraction (I)	7	0.18	1.26
Missing teeth due to caries (M)	7	0.08	0.56
Filled teeth (F):			
1 surface restoration	20	0.13	2.60
2 surface restoration	24	0.04	0.96
3 surface restoration	24	0.01	0.24
PFA for decayed teeth (d)	4	0.36	1.44
Teeth indicated for extraction (i)	7	0.02	0.14
Teeth missing due to any reason (m)	7	0.02	0.14
Scaling per sextant	6.7	2.03	13.60
Other			0.10
Total			39.68
Annual increment assuming 6 years of primary school			6.61

NB

1. I and i estimates include those for caries and other reasons.
2. F estimates calculated on the assumption that the proportion of 1, 2 and 3 surface restoration is identical to that for decayed (D) teeth i.e. 71.4% 1 surface restoration, 20% 2 surface restoration, and 8.6% 3 surface restoration.
3. PFA estimates based on the difference between total number of decayed primary teeth and those indicated for extraction in the 6-7 and 8-10 years age group.
4. Scaling estimates based only on number of sextants affected by calculus in the 11-14 years age group.
5. "Other" represents estimates not covered by the other treatment types.

Table 54 WESTERN HIGHLANDS PROVINCE - ESTIMATED DENTAL THERAPIST
WORK-FORCE REQUIREMENTS FROM SURVEY DATA - SCHOOL DENTAL
SERVICES (INCREMENTAL CARE BASED ON 12 MONTH RECALL PERIOD)

Treatment category	Range of services					
	Type 1	Type 2	Type 3	Type 4	Type 5	Type 6
Examination	*	*	*	*	*	*
Dental health education	*	*	*	*		
Prophylaxis	*	*				
Restorative care - permanent dentition	*	*	*	*	*	*
Extractions	*	*	*	*	*	*
PFA - primary dentition	*	*	*		*	
Scaling	*					
Workforce requirements (operator years):						
1st year of incremental care for 6 grades of primary school (backlog and annual disease increment)	19.84	15.26	13.11	12.63	10.96	10. 53
Maintenance care for 6 grades of primary school (annual disease increment)	8.63	8.05	5.48	5.42	2.92	2.85

Table 55 WESTERN HIGHLANDS PROVINCE - CALCULATION METHOD FOR
ESTIMATING DENTAL THERAPIST WORKFORCE REQUIREMENTS FROM
SURVEY DATA - SCHOOL DENTAL SERVICES - TYPE 6 MODE OF CARE

Relevant considerations

1. Treatment category and treatment times per person
Examination - 7 mins
Unmet needs (excluding periodontal care and PFA) - 20.14 mins
Annual dental disease increment (excluding periodontal care and PFA) - 4.11 mins
2. Primary school population 6-14 years = 23117
3. 1500 hours of patient care per operator per year
4. 6 grades of primary school

Calculation method

1. Workforce requirements for unmet needs (backlog):
$$\frac{1500 \times 60}{7 + 20.14} = 3316.14; \quad \frac{23117}{3316.14} = 6.97 \text{ operator years}$$

Therefore average operator years required for treating unmet needs
$$= \frac{6.97}{6} = 1.16 \text{ operator years}$$

2. Workforce requirements for maintenance care:
$$\frac{1500 \times 60}{7 + 4.11} = 8100.81; \quad \frac{23117}{8100.81} = 2.85 \text{ operator years}$$

Therefore, average operator years required for maintenance care
$$= \frac{2.85}{6} = 0.48 \text{ operator years}$$

3. Workforce requirement for 1st year of incremental care for 6 grades of primary school
$$6.97 + 1.16 + (5 \times 0.48) = 10.53 \text{ operator years}$$

NB:

1. Calculations based on assumption that there are equal numbers of persons at each grade.
2. Estimated primary school population (6-14) years of Western Highlands Province in 1986 was 23117. This figure is obtained by taking into account the annual provincial population growth rate of 2.1%, and that approximately 32% of those between 6-14 years attend primary school (Dept of Health 1986).

6.3.2.2 PRIMARY HEALTH CARE WORKERS

From the above, it can be seen that the dental training of primary health care workers, especially the aid post orderly, is crucial in terms of the existing dental needs and resources. The majority of aid post orderlies are based in rural communities. There is minimal travel by these workers between communities. Also, in a society where tribal fighting is still prevalent, aid post orderlies would often insist on working in their tribal place of origin. Hence, it would be impractical to estimate workforce requirement on methods similar to those for dental therapists.

Personal experience of this author suggests that it would be possible to train several aid post orderlies annually in achieving competency in dental health education and oral hygiene instruction. However, for the various dental clinical skills mentioned, only about 5 to 10 could be trained yearly. This is due to difficulties involved with onsite training given access and transport constraints. It is envisaged that training would be conducted primarily by the provincial dental officer.

6.3.2.3 OTHER DENTAL WORKFORCE CATEGORIES

Given that some provinces in the country are without dental officers, it is unlikely that there would be any addition of this category of personnel to this province in the near future. It is suggested that the 2 dental technicians, and the few and varying numbers of dental orderlies, be reorientated and trained to play a bigger role in dental health education and promotion. Also dental orderlies could be trained in providing dental clinical services similar to those

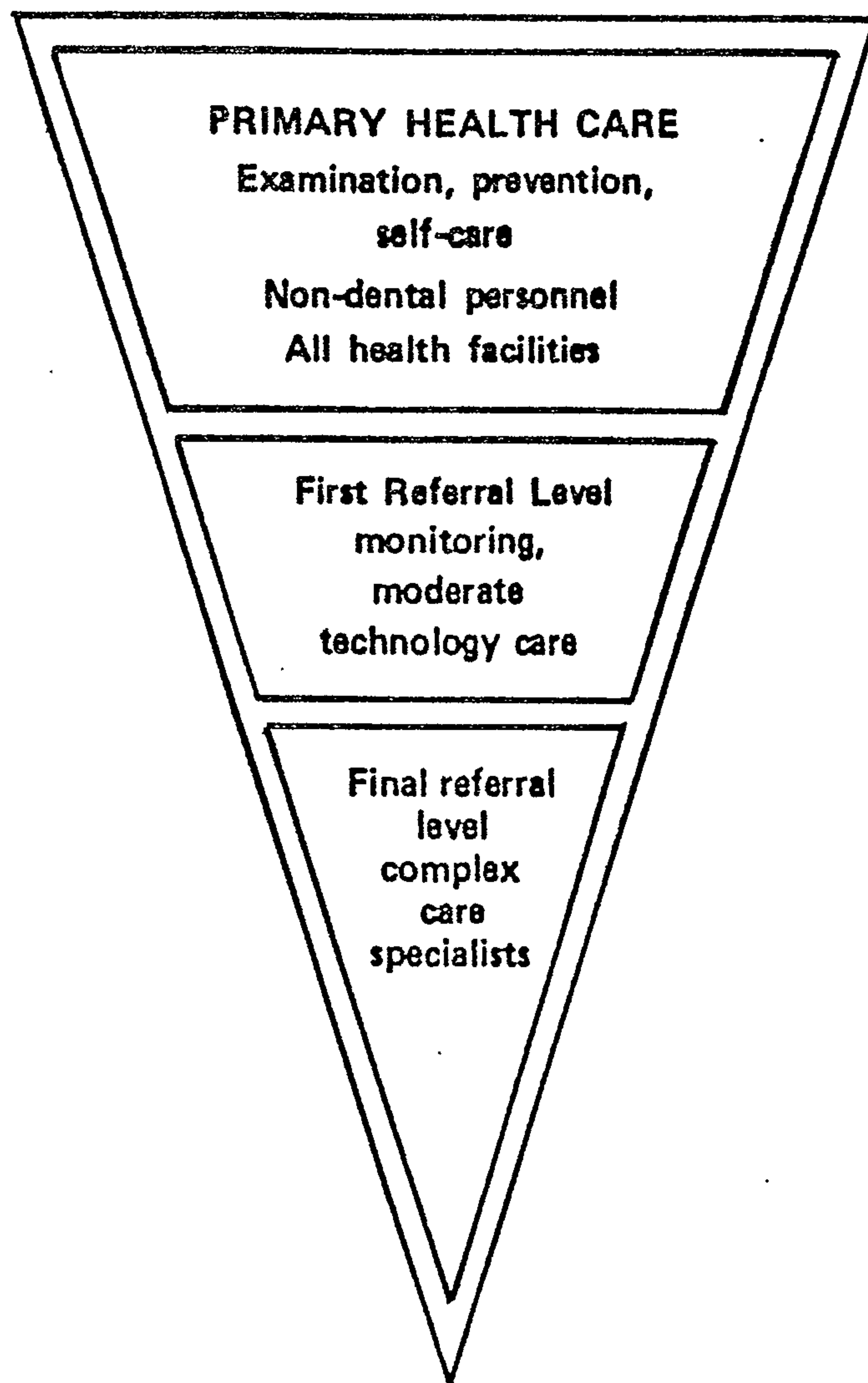
envisaged for aid post orderlies.

6.3.2.4 ROLE OF DENTAL CARE PROVIDERS

The above discussion on dental workforce requirements has highlighted the importance of an appropriate role for the various types of personnel. It would appear that the WHO model of oral health personnel for dental health services delivery (Figure 13) is not only appropriate but desirable for the province. This model, based on the concept of a fully integrated health team approach, emphasises management, quality control and systematic evaluation of programmes (Songpaisan 1985). It comprises a specialist in oral health at the final referral level, dental auxiliaries of varying types at the first referral level, and non dental personnel at the primary care level.

Adapting this concept to the provincial situation, the role of the provincial dental officer would be one of assuming leadership in planning, developing, monitoring and evaluating programmes. This officer is responsible for the provision of complex care, and the training and supervision of dental auxiliaries and primary health care workers. The dental therapist on the other hand, is seen to be the main provider of routine school and adult services. In addition, this person would be required to monitor and supervise primary health care activities, and be responsible for the referral of those needing complex care by the dentist. Finally, the role of primary health care workers e.g. the aid post orderly is one of promoting dental health in the community. They would be involved in the teaching of oral hygiene practices and oral health education; and the provision of preventive services and care based on simple technology.

FIGURE 13 WHO ORAL HEALTH PERSONNEL MODEL (PREPARED
AT WHO 1983)



6.3.3 DENTAL FACILITIES AND EQUIPMENT

Resources permitting, rural dental clinics staffed by dental therapists should be set up in health centres. This would facilitate the delivery of dental care, and the training of non dental personnel. In addition, the monitoring and supervision of primary health care activities would be enhanced.

The use of appropriate and less costly equipment systems is imperative for the success of dental programmes. Portable and mobile systems based on simple technology, as opposed to fixed systems, would ensure greater flexibility. Investigations should be made at the national level into the possibilities of developing new and appropriate equipment systems. Faulty equipment is often not repaired due to lack of trained personnel. Hence the national dental authorities should consider the improvement and upgrading of the existing national equipment maintenance repair facility as an urgent priority.

6.3.4 DENTAL CARE SERVICES FUNDING

At present, funding levels for dental health services in the province and nationally are similar i.e. approximately 3 to 4.5% of their total health budgets respectively. This is compared to the 5 to 11% in Western countries (Renson 1984). However, given general disease patterns, and disease morbidity and mortality statistics, the low priority status and funding level of dental health services are unlikely to improve. Hence dental health services would have to make the optimum use of existing resources.

Resources could be reallocated towards the improved funding of

training and educational programmes. More dental therapists should be trained, and perhaps if necessary, at the expense of training fewer dentists. It is also suggested that priority be given to dental training for non dental health staff especially at the primary care level. The insertion of a dental curriculum into the formal training programmes of such workers e.g. health extension officers, nurses, aid post orderlies etc is considered vital in combatting dental disease in the country. Such a curriculum should emphasise the promotion of good dental health through dental health education, and the detection of oral disease.

6.3.5 MEASURABLE GOALS FOR DENTAL PROGRAMMES

There are 2 main types of measurable goals (WHO 1980b). One is related to disease measurement while the other is to the coverage of the population. The present WHO guidelines (Barmes 1983b; Barmes, Leous 1986) to assist the development of dental programmes in developing countries are as follows:

- a) Caries status at 12 years of age (where average DMFT per child 2.0)
 - DMFT level not to exceed interval 2.5 - 3.0
- b) Periodonal disease status at 12 years of age - not less than 3 healthy sextants per child.

With the survey data implications, and using the above guidelines, the following goals for dental health services in the province are suggested. The goals are based on a 5 year dental health plan. These would facilitate the monitoring and systematic evaluation of dental programmes.

1. Goals for prevention

Supervised fluoride rinsing programme for urban schools

The estimated time required for a fortnightly fluoride rinsing programme is 20 minutes per 30 children. The programme is to be run by teachers with supervision by dental technicians, dental orderlies, and by other health staff e.g. health extension officers, nurses, aid post orderlies etc. The suggested goals are:

- a. Complete coverage of all 7 urban primary schools in every year of the plan
- b. The maintenance of survey DMFT levels

Oral hygiene education

Suggested goals are:

- a. The introduction in the use of toothbrushes and fluoridated toothpastes in 5% of the population in one rural community in each year of the plan. The percentage to be achieved is to be adjusted according to the size of the community.
- b. The provision of dental health education at maternal and child health clinics held in the main provincial hospital and the 17 health centres and health sub centres. This is to be conducted by both dental and non dental health personnel once every 6 months throughout the period of the plan.

2. Goals for primary school dental services

Caries

The survey data indicated that 48% of persons in the primary school population (6-14 years) were affected by untreated decay. Dental services data (see Table 12) suggests that the coverage of the school population was approximately 70% between 1981-1985. With this information, the following goals are suggested:

- a. 50% coverage of the school population on an annual basis, providing conservative treatment for the permanent dentition, and emergency treatment for the primary dentition in the first year of the plan. The services are to be provided by dental therapists. Subsequent annual coverage is to be dependent on workforce numbers.
- b. A reduction in the percentage of persons with untreated decay by half the present levels to 24% in the first year of the plan. Subsequent annual reduction is to be dependent on workforce numbers.
- c. The maintenance of survey DMFT levels in the urban school population (7 schools with estimated population of 3000).

Periodontal disease

The periodontal disease prevalence at 11-14 years (survey data) and the WHO (1980b) classification of moderate periodontal disease prevalence and severity are as follows:

	WHP	WHO
% of persons affected by gingival bleeding	99	21-50
% of persons affected by calculus	90	51-80
Mean number of sextants affected by gingival bleeding	1.8	0.6 - 1.5
mean number of sextants affected by calculus	2.7	1.6 - 2.5

The aim of suggested goals is to reduce the present high levels of the disease to the upper limit of the moderate levels set by the WHO. It is envisaged that the bulk of the oral care education and clinical services would be provided by dentally trained aid post orderlies.

The following goals are for those between 11-14 years only:

- a. The reduction of the percentage of persons affected by gingival bleeding to 50% by the end of 5 years.
- b. The maintenance of the percentage of persons affected by calculus at 90%, with gradual reductions as more aid post orderlies are trained to provide periodontal care.
- c. The increase in the number of healthy sextants to 2.5 (at present 1.9) sextants per person.

3. Goals for the training of primary health care workers

All dental training of non dental personnel in the province is to be conducted by the provincial dental officer, and assisted by other dental staff. The suggested goals are:

- a. The training of 20 aid post orderlies in the provision of dental health education and oral hygiene instruction in the first year. The number of personnel is to be increased by five in each succeeding year giving a total of 40 trained aid post orderlies at the end of the plan.
- b. The training of 5 aid post orderlies in dental clinical services in the first year. This is to be increased by 3 in each succeeding year giving a total of 17 at the end of the plan.

Dental skills to be taught are envisaged to include dental

- examination and simple diagnosis, tooth extractions, prolonged fluoride application treatment, and calculus and plaque removal.
- c. The provision of inservice training for all health extension officers in matters of dental health education and promotion on a yearly basis.
 - d. The training of 2 school teachers from each urban school on a yearly basis. This is to allow for the efficient running of the school fluoride rinsing programme.

4. Goals for dental services on demand

The annual present demand for services in the province is approximately 7% of the adult population (see Table 12). Demand for services is dependent on several factors such as the range of services provided; the number and capabilities of the dental workforce; dental facilities; the education of the public in utilising dental services etc. The provincial dental services, as shown by the data, are already not coping with the existing dental needs. Given that workforce increases are unlikely in the near future, it is felt that the formulation of goals to improve adult demand is not indicated at present. It is envisaged that current levels of adult dental coverage could be maintained with improved dental training of primary health care workers.

7 CONCLUSION

7.1 IMPLICATIONS FOR DENTAL CARE SERVICES

7.1.1 DENTAL HEALTH SERVICES, WESTERN HIGHLANDS PROVINCE

A baseline oral health status survey, utilising WHO methods, was conducted on primary school children in Western Highlands Province in 1983. Survey data indicated that while caries experience was low, it was accompanied by a high rate of untreated dental decay. Endemic levels of periodontal disease in terms of gingival bleeding and calculus were recorded. Although the rates of occurrence of other conditions assessed varied, their treatment needs would appear to be minimal. These conditions refer to dentofacial anomalies, oral mucosal and bone conditions, and tooth defects and abnormalities.

Comparison of survey results suggests that the provincial caries experience may be higher than that in the coastal and island regions of the nation; was lower than that of various South Pacific island states; and was low according to current global dental disease trends. The high periodontal disease prevalence would appear to be consistent with those of developing nations.

Current global trends indicate that caries levels are rising in developing nations especially in urban areas. This is attributed to unfavourable changes in dietary patterns. The poor periodontal status in such nations is considered to be the result of the general neglect of oral hygiene. Conversely, industrialised nations are experiencing declining caries levels and an improving periodontal status. It is suggested that the reasons for this favourable scenario are the

general availability of fluoride; organised oral health education and promotion; readily available dental care services; and the adoption of systematic mouth cleaning habits.

Survey data indicated that the provincial dental health services were not coping with existing needs. Although it is difficult to predict what the future dental disease patterns will be in the province, a rise in caries prevalence is likely. This could be the result of increasing urbanisation and the associated increased consumption of refined carbohydrates. Periodontal disease levels will remain high unless oral hygiene practices are adopted in a society with no cultural concept of mouth cleaning. Demand for dental care, while low at present, will probably increase. Factors likely to cause this are the rapidly growing population, urbanisation and greater dental awareness due to improved education levels. The above picture has profound implications for the delivery of dental care in the province as well as Papua New Guinea.

With the scarce resources of a developing nation, and a low priority status in relation to other health problems, dental health services are unlikely to receive large increases in resource allocation. Present constraints such as dental workforce shortages, the lack of equipment and facilities, transport difficulties etc are likely to remain. The adoption of Western style dental delivery systems by developing nations has failed to result in better dental health for their populations. Hence it is imperative that appropriate programmes and strategies are developed to combat dental disease in the province.

Dental programmes should be oriented towards prevention and control, and they should emphasize community involvement at the primary health care level. It may well be necessary to accept the presence of some untreated disease if a significant proportion of dental disease can be prevented, and hence reduce the need for costly restorative services. Cost effective fluoride methods should be considered for caries prevention. The incorporation of dental health education and promotion into general health education is important. It is suggested that dental health messages be devoted to changes of behaviour and directed at target groups.

The planning of dental programmes must take into account existing needs and resources. Central to this is the appropriate role and training of dental care providers. The primary role of the provincial dental officer should be one of assuming leadership in the planning, implementation and evaluation of programmes. Dental therapists and other dental auxiliaries would be the main providers of routine dental services. The dental training of primary health care workers such as the aid post orderly would greatly enhance dental care delivery. It is recommended that these workers be actively involved in dental health education, and the provision of preventive and clinical services based on simple technology.

With population groups scattered throughout the province in dispersed settlements, rural dental clinics staffed by dental therapists should be set up whenever feasible. This would improve the delivery and accessibility of dental services, and the supervision of primary health care activities. Also the use of appropriate and less costly

equipment systems is critical to the success of programmes. Portable and mobile systems based on simple technology, as opposed to fixed systems, would ensure greater flexibility.

Finally, the development of measurable goals should be an integral part of the planning process. This would enable the monitoring and systematic evaluation of programme activities leading to problem identification and intervention, forward planning and indicated directional changes.

7.1.2 NATIONAL DENTAL HEALTH SERVICES, PAPUA NEW GUINEA

The implications of the survey data suggest that the national dental authorities must ensure that the training of dental personnel is appropriate to the needs and resources of the nation. An appreciation of the importance of "public health" is vital particularly with dental officers. The introduction of a dental curriculum into the formal training of primary health care workers is urgently needed. Such a curriculum should emphasise prevention through dental health education and promotion, and the detection of dental diseases.

Community water fluoridation and supervised school fluoride rinsing programmes are cost effective methods in caries prevention. These are measures that do not require individual initiative and changes in behaviour. Hence investigation into the feasibility and appropriateness of their utilisation for urban centres and schools should be conducted. Also it is suggested that sugar consumption levels be monitored on a regular basis to allow timely intervention.

Faulty dental equipment is often unrepaired due to the lack of adequate maintenance and repair facilities. Hence it is recommended that the national facility for such purposes be improved together with adequate personnel training. Efforts could be made to promote the standardisation of dental equipment based on existing national guidelines among the provinces. Research should be conducted into the development of less complex and more affordable methodology, technology and equipment.

Finally, the regular appraisal of dental disease patterns and needs for care is crucial for a developing nation. An efficient reporting system by the provinces to the national dental authorities would provide invaluable information. Relevant dental epidemiological studies should be promoted in the provinces. Data from such studies would facilitate the choosing of priorities; the development of appropriate programmes and strategies; the estimation of workforce requirements; and the identification of groups and areas with the greatest need for care. This will in turn enhance the maximal utilisation of scarce and costly resources.

7.2 RECOMMENDATIONS

With the implications of the survey data, the following recommendations are suggested for the provincial and national dental health services. The recommendations for the provincial dental health services are to be considered together with section 6.3.5 - "Measurable goals for dental programmes".

7.2.1 DENTAL HEALTH SERVICES, WESTERN HIGHLANDS PROVINCE

1. The introduction of a supervised fluoride mouth rinsing programme based on a fortnightly regimen in all urban primary schools.
2. The provision of dental health education for specific target groups viz expectant mothers, parents, school teachers, school children, health care providers etc.
3. The training of primary health care workers and non operating dental staff in the provision of dental health education and oral hygiene instruction.
4. Based on survey data, and existing dental therapist workforce numbers, the provision of annual school dental care for 50% of the primary school population.
5. Based on survey data, the application from the national dental authorities for the temporary addition of 5 dental therapists to the province for one year. This would enable the treatment of dental disease backlog in the first year of an incremental care school dental programme covering 100% of primary school children. After the first year of the programme, the 7 dental therapists already in the province could maintain the programme on an annual basis (see section 6.3.2.1).

6. The training of aid post orderlies in the province in preventive and curative dental clinical skills based on simple technology.
7. The utilisation of aid post orderlies in the provision of school dental care under the supervision of dental personnel. Their role should be one of providing oral hygiene instruction; prolonged fluoride application treatment; calculus and plaque removal; and tooth extractions.
8. The utilisation of aid post orderlies in the provision of periodontal care for adults in terms of calculus and plaque removal. The control of periodontal disease by dental personnel should primarily be limited to promotional, educational and supervisory roles.
9. The setting up of rural dental clinics staffed by dental therapists.
10. The investigation into the feasibility of community water fluoridation in the provincial capital.
11. The investigation into the feasibility of supplying oral hygiene implements to rural primary schools.
12. The encouragement of rural trade store owners to stock oral hygiene implements. This is to be complimented by dental health promotion and education at the primary care level.

7.2.2 NATIONAL DENTAL HEALTH SERVICES, PAPUA NEW GUINEA

1. The development of appropriate training for dental personnel particularly the dental officer and the dental therapist.
2. The introduction of a dental curriculum into the formal training of primary health care workers.

3. The investigation into the feasibility of community water fluoridation and supervised school fluoride rinsing programmes in all urban centres.
4. The monitoring of national sugar consumption levels on a regular basis.
5. The improvement and upgrading of the national dental equipment maintenance and repair facility.
6. The standardisation of dental equipment systems in the provinces based on national guidelines.
7. The research into the development of appropriate dental delivery systems.
8. The improvement of the existing provincial dental reporting system to the national dental authorities.
9. The monitoring and evaluation of dental disease patterns and trends by conducting regular epidemiological surveys.

8 REFERENCES

- Adkins BL, Barmes DE, Schamschula RG (1974).
Etiology of caries in Papua New Guinea. The trace element content of urine samples and its relation to individual dental caries experience.
Bull Wld Hlth Org 50:495-504.
- Ainamo J, Barmes D, Beagrie G, Cutress T, Martin J, Sardo Infirri J (1982).
Development of the World Health Organization (WHO) Community Periodontal Index of Treatment Needs (CPITN).
Int Dent J 32:281-90.
- Anderson DA (1970).
An epidemiological sample survey of dental and oral health in the New Guinea islands region, 1966.
MDS thesis University of Sydney.
- Andreason JO, Pindborg JJ, Hjørting-Hansen E, Axéll T (1986).
Oral health care: more than caries and periodontal disease. A survey of epidemiological studies on oral disease.
Int Dent J 36:207-14.
- Atkinson JL, Chester IC, Smyth FG, Seldam REJ (1964).
Oral cancer in New Guinea.
Cancer 17:1289-98.
- Bailit HL, Ogan E, Leigh R (1968).
Oral health of the Nasioi of Bougainville.
Aust Dent J 13:353-9.
- Barmes DE (1962).
Dental disease patterns related to dietary patterns in primitive peoples of the Territory of Papua and New Guinea.
DDSc thesis University of Queensland.
- Barmes DE (1967).
Dental and nutritional surveys of primitive peoples in the Pacific Islands.
Aust Dent J 12:442-54.
- Barmes DE (1968a).
Epidemiology in Papua-New Guinea Part I. Dental caries.
Aust Dent J 13:302-12.
- Barmes DE (1968b).
Epidemiology in Papua-New Guinea Part II. Dental caries.
Aust Dent J 13:375-80.
- Barmes DE (1969).
Caries etiology in Sepik villages - trace element, micronutrient and macronutrient content of soil and food.
Caries Res 3:44-59.
- Barmes DE (1979).
Oral health status of children - An international perspective.
Can Dent Assoc J 12:651-58.
- Barmes DE (1983a).
Personal communication.

Barmes DE (1983b).
Indicators for oral health and their implications for developing countries.
Int Dent J 33:60-6.

Barmes DE (1983c).
Review of the South Australian School Dental Service.
Geneva: World Health Organisation.

Barmes DE (1984).
Prevalence of periodontal disease. In: Frandsen A, ed. Public health aspects of periodontal disease.
Chicago: Quintessence.

Barmes DE (1988).
Personal communication.

Barmes DE, Adkins BL, Schamschula RG (1970).
Etiology of caries in Papua New-Guinea. Associations in soil, food and water.
Bull Wld Hlth Org 43:769-84.

Barmes DE, Leous PA (1986).
Assessment of periodontal status by CPITN and its applicability to the development of long term goals on periodontal health of the population.
Int Dent J 36:177-81.

Barmes DE, Sardo-Infirri J (1982).
Global aspects of caries prevention. FDI/WHO/Kellogg Foundation Joint Conference on Fluorides, Vienna, Austria.
Geneva: World Health Organisation.

Barmes DE, Schamschula RG (1967).
Dental education in Papua New Guinea Part II. Integrated dental officer and dental nurse courses.
Aust Dent J 12:34-41.

Barnard PD (1983).
Personal communication.

Barnard PD, Woods R, Cutress T (1976).
Oral health in Western Samoan school children
Unpublished report.

Baume LJ (1969).
Caries prevalence and caries intensity among 12,344 school children of French Polynesia.
Arch Oral Biol 14:181-205.

Baume LJ (1973).
The pattern of dental disease in French Polynesia.
Int Dent J 23:579-84.

Beck DJ, Ludwig TG, Williams JF, Talagi S (1964).
A simple method for public health dental surveys in developing countries.
NZ Dent J 60:274-90.

Bule GF (1986).

Survey of dental caries experience of 6, 9 and 11 year old Ni-vanuatu school children in Vila.

DPH Dent thesis University of Sydney.

Burt BA (1982).

New priorities in prevention of oral disease.

J Public Health Dent 42:170-79.

Cadell PB (1959).

Dental conditions amongst native Nauruans.

Aust Dent J 4:389-94.

Camrass R (1974).

An oral health survey of Western Samoans.

Comm Dent Oral Epidemiol 2:12-9.

Clarke DJ (1978).

Food habits of the people of Papua New Guinea. A handbook for field workers.

Mt Hagen Papua New Guinea.

Commission on Oral Health, Research and Epidemiology (1982).

An epidemiological index of developmental defects of dental enamel (DDE index).

Int Dent J 32:159-67.

Commonwealth Department of Health (1987).

Dental health of children in Australia 1977-1986.

Canberra: Australian Government Publishing Service.

Craig GG (1981).

Towards a rational approach to topical fluoride therapy at the mixed dentition stage.

Int Dent J 31:121-24.

Craig GG (1988).

Personal communication.

Craig GG, Powell KR (1979).

Dental caries in susceptible fissures after prolonged fluoride application.

Comm Dent Oral Epidemiol 7:158-60.

Craig GG, Powell KR, Cooper MH (1981).

Caries progression in primary molars: 24-month results from a minimal treatment programme.

Comm Dent Oral Epidemiol 9:260-5.

Cutress TW (1984).

Oral health versus oral waste.

Dent Today 1,1:2-7.

Cutress TW (1986).

Periodontal health and periodontal disease in young people: global epidemiology.

Int Dent J 36:146-52.

Cutress TW, Suckling GW (1982).
The assessment of noncarious defects of enamel.
Int Dent J 32:117-22.

Davis P (1980)
The social context of dentistry.
London: Croom Helm.

Dental Health Services (1987).
Annual dental statistics 1980-1986.
Department of Health Papua New Guinea.

Department of Education (1983).
Annual report.
Papua New Guinea: Government Printer Port Moresby.

Department of Finance (1984).
Estimates of revenue and expenditure for the year ending 31st December
1983.
Papua New Guinea: Government Printer Port Moresby.

Department of Health (1979).
Special article: Guidelines for medical research projects carried out
in Papua New Guinea.
Papua New Guinea Med J 22:100-3.

Department of Health (1980a).
Annual report 1975-76.
Papua New Guinea: Government Printer Konedobu.

Department of Health (1980b).
Annual report 1976-77.
Papua New Guinea: Government Printer Konedobu.

Department of Health (1980c).
Annual report 1977-80.
Papua New Guinea: Government Printer Konedobu.

Department of Health (1981).
Health in New Guinea.
Department of Health Papua New Guinea.

Department of Health (1982).
Information Handbook.
Papua New Guinea: Government Printer Konedobu.

Department of Health (1984).
Annual report 1983 (covering 1980-83).
Papua New Guinea: Government Printer Konedobu.

Department of Health (1986).
Papua New Guinea National Health Plan 1986-1990.
Department of Health Papua New Guinea

Department of Public Health (1974).
Papua New Guinea National Health Plan 1974-1978.
Department of Public Health Papua New Guinea.

Department of Public Health (1977).
Annual report 1974-75.
Papua New Guinea: Government Printer Konedobu.

Dissanayake SB (1985).
Dental health care: the changing scene.
Odontostomatol Trop 8:215-6.

Division of Education (1983).
School Enrolment Figures.
Department of Western Highlands Papua New Guinea.

Division of Health (1983-1984).
Budget estimates.
Department of Western Highlands Papua New Guinea.

Dunning JM (1980).
Principles of dental public health. 3rd ed.
Cambridge: Harvard University Press.

Elderton RJ (1985).
The failure of restorative dentistry: lessons for developing countries.
Dent Today 2,2:1-10.

Enno A, Craig GG (1982).
Economic aspects of the prolonged fluoride application method.
Aust Dent J 27:91-3.

Fédération Dentaire Internationale (1984).
The prevention of dental caries and periodontal disease.
Tech Rep No 20.
Int Dent J 34:141-58.

Fédération Dentaire Internationale/World Health Organization (1985).
Changing patterns of oral health and implications for oral health manpower: Part I.
Int Dent J 35:235-51.

Gjeramo P, Bellini HT, Marcos B (1983).
Application of the Community Periodontal Index of Treatment Needs (CPITN) in a population of young Brazilians.
Comm Dent Oral Epidemiol 11:342-6.

Goodman R, Lepani C, Morawetz D (1985).
The Economy of Papua New Guinea - An independent review.
A report to the government of Papua New Guinea and the government of Australia.
Canberra: Development Studies Centre The Australian National University.

Hollis MJ, Malaki T (1974).
Fluorosis and dental caries in the Ellice Islands.
NZ Dent J 70:181-4.

Horowitz HS (1982).
The potential of fluorides and sealants to deal with problems of dental decay.
Pediatr Dent 4:286-95.

Howden GF (1984).

The cariostatic effect of betel nut chewing.

Papua New Guinea Med J 27:123-31.

Humphreys JR (1977).

Prevalence survey on the dental health status of primary school children in Papua New Guinea.

Department of Health Papua New Guinea.

Hunter J (Ed) (1985).

Papua New Guinea Handbook - Business and Travel Guide. 11th ed.

Sydney: Pacific Publications.

Ibikunle SAJ (1985).

The implications of changing patterns in oral health for the general practice of dentistry.

Int Dent J 35:73-7.

Kirkpatrick RM (1935).

Dental caries and odontoclasia in New Guinea.

Dent J Aust 7:707-14.

Kirkpatrick RM (1937).

Diet in relation to gingivitis: field observations in New Guinea.

JADA and Dent Cosmos 24:197-206.

Malden N (1983).

Dentistry in the Southern Highlands of Papua New Guinea.

Br Dent J 154:297-9.

Manji F, Sheiham A (1986).

CPITN findings and the manpower implications of periodontal treatment needs for Kenyan children.

Comm Dent Health 3:143-51.

Masi MB (1973).

The pattern of dental disease in the South Pacific area of the Pacific basin.

Int Dent J 23:573-8.

May RJ (1984).

Kaikai aniani - A guide to bush foods, markets and culinary arts of Papua New Guinea.

Sydney: Robert Brown and Associates.

McDowell BH (1953).

A survey of dental conditions among the Cook Island natives.

NZ Dent J 49:19-24.

McIntyre J (1987).

Personal communication.

Meiers JC, Jensen ME (1984).

Management of the questionable carious fissure: invasive vs noninvasive techniques.

J Am Dent Assoc 108:64-8.

- Meiers JC, Wirthlin MR, Shklair IL (1982).
A microbiological analysis of human early carious and noncarious fissures.
J Dent Res 61:460-4.
- Millar B (1983).
The highlands of Papua New Guinea.
Sydney: Robert Brown and Associates.
- Miller SL (1981).
Introductory statistics for dentistry and medicine.
Reston Virginia: Reston Publishing.
- Møller IJ (1978).
Impact of oral diseases across cultures.
Int Dent J 28:376-82.
- Møller IJ (1979).
Preventive responses to various national problems.
Int Dent J 29:208-14.
- Møller IJ (1982).
Fluorides and dental fluorosis.
Int Dent J 32:135-47.
- Mura R, Hollis MJ (1974).
Dental epidemiology in the South Pacific - Part I.
Noumea New Caledonia: South Pacific Commission.
- National Statistical Office (1982).
1980 National population census final figures: census unit populations
Western Highlands Province, Papua New Guinea.
Port Moresby: Papua New Guinea.
- National Statistical Office (1985).
Papua New Guinea 10 years in figures.
Port Moresby: Papua New Guinea.
- Papua New Guinea Consulate General (1986).
Government.
Sydney: Papua New Guinea Consulate.
- Pindborg JJ (1982).
Aetiology of development enamel defects not related to fluorosis.
Int Dent J 32:123-34.
- Pitts NB (1983).
Monitoring of caries progression in permanent and primary posterior
approximal enamel by bitewing radiography.
Comm Dent Oral Epidemiol 11:228-35.
- Powell RN, Cutress TW (1981).
Changing patterns of caries prevalence in Tongatapu.
Odontostomatol Trop 4:221-7.
- Pulu AI (1984).
Niue public dental health services - An evaluation 1965-1983.
DPH Dent thesis University of Sydney.

Meiers JC, Wirthlin MR, Shklair IL (1982).
A microbiological analysis of human early carious and noncarious fissures.
J Dent Res 61:460-4.

Millar B (1983).
The highlands of Papua New Guinea.
Sydney: Robert Brown and Associates.

Miller SL (1981).
Introductory statistics for dentistry and medicine.
Reston Virginia: Reston Publishing.

Møller IJ (1978).
Impact of oral diseases across cultures.
Int Dent J 28:376-82.

Møller IJ (1979).
Preventive responses to various national problems.
Int Dent J 29:208-14.

Møller IJ (1982).
Fluorides and dental fluorosis.
Int Dent J 32:135-47.

Mura R, Hollis MJ (1974).
Dental epidemiology in the South Pacific - Part I.
Noumea New Caledonia: South Pacific Commission.

National Statistical Office (1982).
1980 National population census final figures: census unit populations
Western Highlands Province, Papua New Guinea.
Port Moresby: Papua New Guinea.

National Statistical Office (1985).
Papua New Guinea 10 years in figures.
Port Moresby: Papua New Guinea.

Papua New Guinea Consulate General (1986).
Government.
Sydney: Papua New Guinea Consulate.

Pindborg JJ (1982).
Aetiology of development enamel defects not related to fluorosis.
Int Dent J 32:123-34.

Pitts NB (1983).
Monitoring of caries progression in permanent and primary posterior
approximal enamel by bitewing radiography.
Comm Dent Oral Epidemiol 11:228-35.

Powell RN, Cutress TW (1981).
Changing patterns of caries prevalence in Tongatapu.
Odontostomatol Trop 4:221-7.

Pulu AI (1984).
Niue public dental health services - An evaluation 1965-1983.
DPH Dent thesis University of Sydney.

Reilly Q (1985).

The decentralisation of health services in Papua New Guinea - the problem, the method and the results. Monograph no. 1.
Department of Health Papua New Guinea.

Renson CE (1984).

Changing patterns and concepts of oral disease: the effects of future manpower needs.
Dent Today 1,3:1-8.

Sardo-Infirri J (1983).

Personal communication.

Sardo-Infirri J, Barmes DE (1979).

Epidemiology of oral diseases - differences in national problems.
Int Dent J 29:183-90.

Schamschula RG, Adkins BL, Barmes DE, Charlton G (1977).

Betel chewing and caries experience in New Guinea.
Comm Dent Oral Epidemiol 5:284-6.

Schamschula RG, Adkins BL, Barmes DE, Charlton G, Davey BG (1978).

WHO study of dental caries etiology in Papua New Guinea.
Offset Publication No. 40.
Geneva: World Health Organisation.

Schamschula RG, Barmes DE (1966).

Dental education in Papua New Guinea Part I. The concept.
Aust Dent J 11:73-80.

Schamschula RG, Barmes DE (1970a).

The lactobacillus flora of saliva and plaque in primitive peoples in Papua-New Guinea.
Aust Dent J 15:28-34.

Schamschula RG, Barmes DE (1970b).

A study of the streptococcal flora of plaque in caries free and caries active primitive peoples.
Aust Dent J 15:377-82.

Schamschula RG, Barmes DE, Adkins BL (1972).

Caries aetiology in Papua New Guinea. Association of tooth size and dental arch width.
Aust Dent J 17:188-95.

Schamschula RG, Barmes DE, Keyes PH, Gulbinat W (1974).

Prevalence and interrelationships of root surface caries in Lufa, Papua New Guinea.
Comm Dent Oral Epidemiol 2:295-304.

Schamschula RG, Keyes PH, Hornabrook RW (1972).

Root surface caries in Lufa, New Guinea I. Clinical observations.
J Am Dent Assoc 85:603-8.

Sheen D (1985).

An analysis of a primary oral health care program in the Eastern Highlands Province of Papua New Guinea.
Unpublished report.

Sheiham A (1974).

Assignment report on dental health, Indonesia.
SEAO 74/123 World Health Organization New Delhi.

Sheiham A (1984).

Strategies for controlling periodontal diseases.
Dent Today 1,2:1-8.

Silverstone LM (1983).

Remineralisation and enamel caries: new concepts.
Dent Update 10:261-73.

Sinclair B, Cameron DA, Goldsworthy NE (1950a).

Some observations on dental conditions in Papua-New Guinea, 1947, with special reference to dental caries - Part I-VI.
Dent J Aust 22:58-93.

Sinclair B, Cameron DA, Goldsworthy NE (1950b).

Some observations on dental conditions in Papua-New Guinea, 1947, with special reference to dental caries - Part VII.
Dent J Aust 22:120-57.

Songpaisan Y (1985).

Manpower and future role of dentistry in developing countries.
Int Dent J 35:78-82.

Soo YS (1979).

A 3 year primary dental health care project for rural health workers in Enga Province.
Division of Health Department of Enga Papua New Guinea.

Speake JD (1980).

Caries prevalence and restorative dental services in some Pacific islands.
Aust Dent J 25:193-6.

Speake JD, Cutress TW, Ball ME (1979).

The prevalence of dental caries and the concentration of fluoride in enamel of children in Pacific Islands.
Tech Paper No. 178.
Noumea New Caledonia: South Pacific Commission.

Speake JD, Malaki T (1982).

Oral health in Tuvalu.
Comm Dent Oral Epidemiol 10:173-7.

Striffler DF, Young WO, Burt BA (1983).

Dentistry, dental practice and the community. 3rd ed.
Philadelphia: Saunders.

Suckling GW, Brown RH, Herbison GP (1985).

The prevalence of developmental defects of enamel in 696 nine year old New Zealand children participating in a health and development study.
Comm Dent Health 2:303-13.

Sutton PRN (1966).

Dental health survey of Gilbert and Ellice Islanders.
Aust Dent J 11:405-9.

Valentine AD (1981).

A community approach to the prevention of dental disease in the children of developing countries.

Int Dent J 31:23-8.

Vele AA (1987a).

Personal communication.

Vele AA (1987b).

Review of dental workforce development and utilisation in Papua New Guinea.

MDS thesis University of Sydney.

Vines P (1968).

An epidemiological sample survey of the Highlands, Mainland and Island Regions of the Territory of Papua New Guinea.

MD thesis University of Sydney.

Williams JF (1958).

Report and plan for the establishment and development of a public health service in the Territory of Papua and New Guinea.

Department of Public Health Papua New Guinea.

Wong KK (1969).

Report of a survey of dental diseases and conditions in Fiji.

WPRO 0115 World Health Organization.

World Health Organization (1962).

Standardisation of reporting of dental diseases and conditions.

Report of an expert committee on dental health.

Tech Rep Ser No. 242.

Geneva: World Health Organization.

World Health Organization (1971).

Oral health surveys - Basic methods.

Geneva: World Health Organization.

World Health Organization (1972).

Statistical principles in public health field studies.

Fifteenth report of WHO expert committee on health statistics.

Tech Rep Ser No. 510.

Geneva: World Health Organization.

World Health Organization (1977).

Oral health surveys - Basic methods. 2nd ed.

Geneva: World Health Organization.

World health Organization (1978a).

Application of the international classification of diseases to dentistry and stomatology.

ICD-DA 2nd ed.

Geneva: World Health Organization.

World Health Organization (1978b).

Epidemiology, etiology and prevention of periodontal diseases.

Report of a WHO scientific group.

Tech Rep Ser No. 621.

Geneva: World Health Organization.

World Health Organization (1979).
A guide to oral health epidemiological investigations.
Oral Health Unit.
Geneva: World Health Organization.

World Health Organization (1980a).
Guide to epidemiology and diagnosis of oral mucosal diseases and conditions.
Comm Dent Oral Epidemiol 18:1-26.

World Health Organization (1980b).
Planning oral health services.
Geneva: World Health Organization.

World Health Organization (1984).
Prevention methods and programmes for oral diseases.
Report of a WHO expert committee.
Tech Rep Ser No. 713.
Geneva: World Health Organization.

World Health Organization (1985).
Oral health care systems - An international collaborative study.
London: Quintessence.

World Health Organization (198?).
Leaflet for field use with the WHO Pathfinder Oral Health and Treatment Assessment Form with CPITN.
Oral Health Division of Noncommunicable Diseases.
Geneva: World Health Organization.

Yule AJ (1968).
Dental disease of Nauru Island.
MDS thesis University of Sydney.

Appendix 1 CARRIES STATUS BY ACCESS % PERSONS AFFECTED AND MEAN NUMBERS OF DMFT AND dmft

Code 1 - highway access			Code 2 - mainroad access			Code 3 - access road access			Code 4 - no road access			Code 5 - no road and air access		
Age (yrs)	N	%	DMFT	N	%	DMFT	N	%	DMFT	N	%	DMFT	N	%
6-7	23	44	0.9	9	67	0.9	11	36	0.7	3	0	0.0	5	40
8-10	346	35	0.7	447	37	0.7	380	40	0.7	39	36	0.6	50	38
11-14	544	57	1.5	1363	58	1.5	1472	59	1.6	305	56	1.5	319	58
Code 1			Code 2			Code 3			Code 4			Code 5		
Age (yrs)	N	%	dmft	N	%	dmft	N	%	dmft	N	%	dmft	N	%
6-7	23	65	2.5	9	89	3.3	11	64	2.7	3	33	0.7	5	60
8-10	346	61	1.8	447	58	1.4	380	65	1.8	39	51	0.9	50	34

*% = % persons affected

Appendix 2 CARRIES STATUS BY ACCESS - MEAN NUMBERS OF DMFT AND dmft AND COMPONENTS

		Code 1 - highway access					Code 2 mainroad access					Code 3 - access road access					Code 4 - no road access					Code 5 - no road and air access				
Age (yrs)		N	D	M	F	DMFT	N	D	M	F	DMFT	N	D	M	F	DMFT	N	D	M	F	DMFT	N	D	M	F	DMFT
6-7	23	0.9	0	0	0	0.9	9	0.7	0.1	0.1	0.9	11	0.5	0	0.3	0.7	3	0	0	0	0.0	5	0.4	0.2	0	0.6
8-10	346	0.7	0	0	0	0.7	447	0.7	0	0	0.7	380	0.6	0	0.1	0.7	39	0.6	0	0	0.6	50	0.5	0	0.1	0.6
11-14	544	1.2	0.1	0.1	0	1.5	1363	1.2	0.1	0.2	1.5	1472	1.2	0.2	0.3	1.6	305	1.4	0.1	0	1.5	319	1.2	0.1	0.1	1.3

		Code 1					Code 2					Code 3					Code 4					Code 5				
Age (yrs)		N	d	m	f	dmft	N	d	m	f	dmft	N	d	m	f	dmft	N	d	m	f	dmft	N	d	m	f	dmft
6-7	23	2.4	0.1	0	2.5	3.3	9	3.3	0	0	3.3	11	2.7	0	0	2.7	3	0.3	0.3	0	0.7	5	1.2	0.2	0	1.4
8-10	346	1.7	0.1	0	1.8	447	1.4	0.1	0	1.4	380	1.7	0.1	0	1.8	39	0.9	0	0	0.9	50	0.8	0	0	0.8	

Appendix 3 CRIES STATUS BY ALTITUDE % PERSONS AFFECTED AND MEAN
NUMBERS OF DMFT AND dmft

Age (yrs)	N	*%	D	M	F	DMFT
Code 1 1500 m						
6-7	7	43	0.7	0.1	0.0	0.9
8-10	197	34	0.5	0.0	0.0	0.5
11-14	1019	58	1.2	0.1	0.1	1.5

Code 2 1501-1900 m						
6-7	36	36	0.6	0.0	0.1	0.7
8-10	872	37	0.7	0.0	0.1	0.8
11-14	2315	58	1.1	0.1	0.2	1.5

Code 3 1900 m						
6-7	8	75	0.9	0.1	0.1	1.1
8-10	194	40	0.6	0.0	0.0	0.7
11-14	670	61	1.4	0.1	0.3	1.8

Age (yrs)	N	*%	d	m	f	dmft
-----------	---	----	---	---	---	------

Code 1 1500 m						
6-7	7	57	1.4	0.1	0.0	1.6
8-10	197	45	1.1	0.0	0.0	1.1

Code 2 1501-1900 m						
6-7	36	64	2.4	0.0	0.0	2.5
8-10	872	60	1.5	0.1	0.0	1.6

Code 3 1900 m						
6-7	8	88	3.0	0.3	0.0	3.3
8-10	194	71	1.8	0.0	0.0	1.8

*% = % persons affected

Appendix 4 CRIES STATUS BY SCHOOL % OF PERSONS AFFECTED AND MEAN
NUMBERS OF DMFT 11-14 YEARS

School code	School	N	Access code	Altitude code	*%	D	M	F	DMFT
1	Koinambe	95	4	1	57	1.3	0.2	0.0	1.5
2	Mt Au	71	4	1	69	2.0	0.0	0.0	2.1
3	Tsikisa	42	3	1	62	1.0	0.1	0.5	1.6
4	Kwinkya	120	2	1	57	0.6	0.2	0.5	1.3
5	Tapiakama	59	5	2	63	0.9	0.1	0.4	1.4
6	Kingaringa	68	3	3	52	0.6	0.2	0.4	1.1
7	Lumis	106	3	2	52	0.8	0.2	0.2	1.2
8	Gobo	75	5	1	57	1.2	0.0	0.0	1.2
9	Ambullua	138	4	3	49	1.2	0.0	0.0	1.2
10	Tabibuga	108	2	1	48	1.0	0.1	0.1	1.2
11	Togban	102	5	1	52	1.1	0.1	0.0	1.2
12	Paraka	27	3	1	33	0.8	0.0	0.0	0.8
13	Alimp	55	3	1	51	1.1	0.1	0.2	1.4
14	Nebilyer	84	1	1	60	1.1	0.1	0.1	1.3
15	Kuga	116	1	2	60	1.4	0.1	0.1	1.6
16	Fatima	99	2	2	65	1.2	0.2	0.0	1.4
17	St Anselm	62	2	2	57	0.8	0.1	0.3	1.2
18	Nondugal St Marys	87	2	2	87	0.9	0.2	0.3	1.4
19	Ambang	80	3	2	60	1.0	0.3	0.6	1.8
20	Millep	83	3	2	64	0.9	0.3	0.3	1.4
21	St John Bosco	76	1	2	67	1.4	0.2	0.2	1.8
22	Kugark	71	2	2	59	0.9	0.2	0.2	1.4
23	Kurumul	95	2	2	95	1.6	0.3	0.2	2.0
24	Piltange	97	3	2	62	1.4	0.0	0.0	1.4
25	Dama	28	3	2	57	1.5	0.3	0.0	1.8
26	Muglamp	103	2	2	53	1.1	0.1	0.0	1.3
27	Nunga	107	2	2	63	1.4	0.2	0.1	1.7
28	Golge	61	3	2	67	1.0	0.1	0.4	1.6
29	Kindeng	13	1	2	62	1.3	0.1	0.1	1.5
30	Kuli	98	3	2	57	1.0	0.2	0.2	1.4
31	Kaip	79	3	2	52	1.1	0.1	0.3	1.5
33	Arawagai	178	3	2	52	1.2	0.1	0.0	1.4
34	Rebiamul	132	1	2	52	1.0	0.2	0.3	1.4
35	Kokglamp	121	2	2	61	1.6	0.1	0.0	1.7
36	Mt Hagen	63	1	2	53	1.0	0.3	0.1	1.4
37	Anga	62	3	2	66	1.1	0.2	0.3	1.6
38	Minimp	14	3	2	79	2.8	0.1	0.2	3.1
39	Malbuga	100	2	1	71	2.0	0.1	0.3	2.5
40	Kelengha	101	3	2	53	1.2	0.1	0.2	1.4
41	Bukapena	88	2	3	53	1.2	0.1	0.1	1.4
42	Tambul	118	2	3	63	1.6	0.1	0.1	1.8
43	Yano	92	3	3	73	1.9	0.3	0.7	2.9
44	Tomba	25	1	3	64	1.3	0.3	0.2	1.7
45	Alkena	86	3	3	78	1.8	0.3	0.3	2.4
46	Kiripia	52	3	3	58	1.2	0.1	0.3	1.6
47	Kosap	80	5	1	63	1.6	0.0	0.0	1.6
48	Tsingaropa	47	3	1	60	1.2	0.1	0.0	1.3
49	Ulga	72	2	2	47	0.8	0.1	0.2	1.1
50	Holy Trinity	32	1	2	38	0.9	0.0	0.0	0.9

*% = % persons affected

Appendix 5 CRIES STATUS BY SCHOOL % OF PERSONS AFFECTED AND MEAN
NUMBERS OF DMFT 8-10 YEARS

School code	School	N	Access code	Altitude code	*%	D	M	F	DMFT
1	Koinambe	15	4	1	20	0.5	0.0	0.0	0.5
2	Mt Au	7	4	1	71	1.0	0.0	0.0	1.0
3	Tsikisa	9	3	1	33	2.0	0.0	0.0	2.1
4	Kwinkya	19	2	1	37	0.4	0.1	0.1	0.6
5	Tapiakama	5	5	2	80	0.6	0.1	1.0	1.6
6	Kingaringa	8	3	3	13	0.1	0.0	0.0	0.1
7	Lumis	13	3	2	54	1.0	0.0	0.1	1.1
8	Gobo	16	5	1	25	0.4	0.0	0.0	0.4
9	Ambullua	18	4	3	33	0.6	0.0	0.0	0.6
10	Tabibuga	31	2	1	32	0.5	0.0	0.0	0.5
11	Togban	12	5	1	25	0.3	0.0	0.0	0.3
12	Paraka	-	3	1	-	-	-	-	-
13	Alimp	8	3	1	25	0.4	0.0	0.0	0.4
14	Nebilyer	32	1	1	22	0.4	0.0	0.0	0.4
15	Kuga	7	1	2	29	1.0	0.0	0.0	1.0
16	Fatima	37	2	2	46	0.8	0.0	0.0	0.8
17	St Anselm	65	2	2	42	0.8	0.0	0.0	0.9
18	Nondugal St Marys	18	2	2	22	0.2	0.1	0.1	0.3
19	Ambang	37	3	2	41	0.5	0.1	0.1	0.8
20	Millep	29	3	2	48	0.8	0.1	0.0	0.9
21	St John Bosco	40	1	2	50	1.1	0.1	0.0	1.1
22	Kugark	48	2	2	31	0.4	0.0	0.1	0.5
23	Kurumul	30	2	2	30	0.5	0.0	0.1	0.5
24	Piltange	20	3	2	45	0.6	0.1	0.0	0.7
25	Dama	18	3	2	22	0.4	0.0	0.0	0.4
26	Muglamp	34	2	2	18	0.3	0.0	0.0	0.4
27	Nunga	10	2	2	50	1.8	0.0	0.0	1.8
28	Golge	-	3	2	-	-	-	-	-
29	Kindeng	6	1	2	33	1.2	0.0	0.0	1.2
30	Kuli	51	3	2	35	0.5	0.0	0.3	0.8
31	Kaip	28	3	2	46	0.8	0.0	0.2	1.0
33	Arawagai	24	3	2	58	1.0	0.1	0.0	1.2
34	Rebiamul	152	1	2	36	0.6	0.0	0.0	0.7
35	Kokglamp	23	2	2	35	0.7	0.0	0.0	0.7
36	Mt Hagen	24	1	2	42	1.1	0.0	0.1	1.2
37	Anga	36	3	2	47	0.7	0.0	0.0	0.8
38	Minimp	-	3	2	-	-	-	-	-
39	Malbuga	18	2	1	56	1.0	0.0	0.0	1.0
40	Kelengha	17	3	3	18	0.3	0.0	0.0	0.3
41	Bukapena	29	2	3	38	0.8	0.0	0.0	0.8
42	Tambul	57	2	3	44	0.8	0.0	0.1	0.9
43	Yano	5	3	3	20	0.2	0.0	0.0	0.2
44	Tomba	12	1	3	50	0.6	0.0	0.0	0.6
45	Alkena	12	3	3	58	0.6	0.3	0.0	0.8
46	Kiripia	47	3	3	40	0.5	0.0	0.1	0.6
47	Kosap	18	5	1	44	0.6	0.0	0.0	0.6
48	Tsingaropa	12	3	1	25	0.3	0.0	0.0	0.3
49	Ulga	26	2	2	35	0.7	0.0	0.0	0.7
50	Holy Trinity	67	1	2	27	0.6	0.0	0.0	0.6

*% = % persons affected

Appendix 6 CRIES STATUS BY SCHOOL % OF PERSONS AFFECTED AND MEAN
NUMBERS OF dmft 8-10 YEARS

School code	School	N	Access code	Altitude code	*%	d	m	f	dmft
1	Koinambe	15	4	1	40	0.6	0.1	0.0	0.7
2	Mt Au	7	4	1	58	0.9	0.0	0.0	0.9
3	Tsikisa	9	3	1	57	0.8	0.0	0.0	0.8
4	Kwinkya	19	2	1	42	0.9	0.0	0.0	0.9
5	Tapiakama	5	5	2	20	0.2	0.0	0.0	0.2
6	Kingaringa	8	3	3	63	1.3	0.0	0.0	1.3
7	Lumis	13	3	2	69	1.5	0.2	0.2	1.9
8	Gobo	16	5	1	38	0.8	0.0	0.0	0.8
9	Ambullua	18	4	3	67	1.2	0.0	0.0	1.2
10	Tabibuga	31	2	1	55	1.4	0.0	0.0	1.4
11	Togban	12	5	1	16	0.6	0.0	0.0	1.6
12	Paraka	-	3	1	-	-	-	-	-
13	Alimp	8	3	1	63	2.1	0.0	0.0	2.1
14	Nebilyer	32	1	1	53	1.8	0.0	0.0	1.8
15	Kuga	7	1	2	100	3.0	0.0	0.0	3.0
16	Fatima	37	2	2	54	1.6	0.0	0.0	1.7
17	St Anselm	65	2	2	62	1.2	0.2	0.0	1.4
18	Nondugal St Marys	18	2	2	33	0.6	0.0	0.0	0.6
19	Ambang	37	3	2	54	0.9	0.2	0.0	1.1
20	Millep	29	3	2	62	1.4	0.2	0.0	1.6
21	St John Bosco	40	1	2	60	2.0	0.2	0.0	2.2
22	Kugark	48	2	2	58	1.4	0.1	0.0	1.5
23	Kurumul	30	2	2	43	0.8	0.1	0.0	0.9
24	Piltange	20	3	2	65	1.4	0.0	0.0	1.4
25	Dama	18	3	2	56	1.3	0.0	0.0	1.3
26	Muglamp	34	2	2	71	1.8	0.1	0.0	1.9
27	Nunga	10	2	2	50	0.8	0.0	0.0	0.8
28	Golge	-	3	2	-	-	-	-	-
29	Kindeng	6	1	2	67	2.2	0.0	0.0	2.2
30	Kuli	51	3	2	63	2.0	0.0	0.0	2.0
31	Kaip	28	3	2	75	2.2	0.0	0.0	2.2
33	Arawagai	24	3	2	71	1.7	0.2	0.0	1.9
34	Rebiamul	152	1	2	62	1.7	0.1	0.0	1.8
35	Kokglamp	23	2	2	52	1.5	0.0	0.0	1.5
36	Mt Hagen	24	1	2	58	1.0	0.4	0.0	1.4
37	Anga	36	3	2	72	1.9	0.3	0.0	2.2
38	Minimp	-	3	2	-	-	-	-	-
39	Malbuga	18	2	1	28	0.5	0.0	0.0	0.5
40	Kelengha	17	3	3	53	1.7	0.0	0.0	1.7
41	Bukapena	29	2	3	66	1.3	0.0	0.0	1.3
42	Tambul	57	2	3	79	2.1	0.0	0.0	2.1
43	Yano	5	3	3	80	1.4	0.0	0.0	1.4
44	Tomba	12	1	3	58	1.0	0.0	0.0	1.0
45	Alkena	12	3	3	50	0.8	0.0	0.0	0.8
46	Kiripia	47	3	3	75	2.4	0.1	0.0	2.5
47	Kosap	18	5	1	44	1.1	0.0	0.0	1.1
48	Tsingaropa	12	3	1	42	0.8	0.0	0.0	0.8
49	Ulga	26	2	2	62	1.4	0.1	0.0	1.5
50	Holy Trinity	67	1	2	60	1.6	0.1	0.0	1.7

*% = % persons affected

Appendix 7 **CARIES STATUS ACCESS BY ALTITUDE % PERSONS AFFECTED AND
MEAN NUMBERS OF DMFT 8-10 YEARS and 11-14 YEARS**

Access code 1 - highway access	Altitude code 1 < 1500 m
2 - mainroad access	2 1501-1900 m
3 - access road access	3 > 1901 m
4 - no road access	
5 - no road and air access	

Age (yrs)	N	*%	D	M	F	DMFT
-----------	---	----	---	---	---	------

Code 1-1 - highway access: < 1500 m

8-10	33	21.2	0.4	0.0	0.0	0.4
11-14	85	60	1.1	0.1	0.1	1.3

Code 1-2 - highway access: 1501-1900 m

8-10	298	35.9	0.7	0.0	0.0	0.7
11-14	434	56	1.1	0.1	0.2	1.5

Code 1-3 - highway access: > 1900 m

8-10	13	46.2	0.5	0.0	0.0	0.5
11-14	25	64	1.3	0.3	0.2	1.8

Code 2-1 - main road access: < 1500 m

8-10	66	39.4	0.6	0.0	0.0	0.6
11-14	332	58.4	1.2	0.2	0.3	1.6

Code 2-2 - main road access: 1501-1900 m

8-10	292	34.6	0.6	0.0	0.0	0.6
11-14	825	58.3	1.2	0.1	0.1	1.4

Code 2-3 - main road access: > 1900 m

8-10	86	43	0.8	0.0	0.0	0.9
11-14	207	58.5	1.3	0.1	0.1	1.6

*% = % persons affected

Access code	1 - highway access	Altitude code	1 < 1500 m
	2 - mainroad access		2 1501-1900 m
	3 - access road access		3 > 1901 m
	4 - no road access		
	5 - no road and air access		

*% = % persons affected

•

•

•

Appendix 9 CRIES STATUS BY AGE
 % OF MEAN DT/MEAN DMFT and
 % OF MEAN dt/MEAN dmft

Age (yrs)	N	DT	DMFT	% DT/DMFT
6-7	51	0.6	0.8	75
8-10	1263	0.6	0.7	86
11-14	4006	1.2	1.5	80

Age (yrs)	N	dt	dmft	% dt/dmft
6-7	51	2.4	2.5	96
8-10	1263	1.5	1.6	94

Appendix 10 CRIES STATUS BY AGE
NUMBER AND % OF PERSONS AFFECTED BY MEAN DMFT and
MEAN DT, and MEAN dmft AND MEAN dt

Age (yrs)	N	DMFT		DT	
		Number	%	Number	%
6-7	51	22	43.1	21	41.2
8-10	1263	469	37.1	442	35
11-14	4006	2326	58.1	2091	52.2

Age (yrs)	N	dmft		dt	
		Number	%	Number	%
6-7	51	34	66.7	34	66.7
8-10	1263	751	59.5	742	58.7

Appendix 11 CRIES STATUS BY ACCESS
% OF MEAN DT/MEAN DMFT

Age (yrs)	N	DT	DMFT	% DT/DMFT
Code 1 - highway access				
6-7	23	0.9	0.9	100
8-10	346	0.7	0.7	100
11-14	544	1.2	1.5	80
Code 2 - main road access				
6-7	9	0.7	0.9	78
8-10	447	0.7	0.7	100
11-14	1363	1.2	1.5	80
Code 3 - access road access				
6-7	11	0.5	0.7	71
8-10	380	0.6	0.7	86
11-14	1472	1.2	1.6	75
Code 4 - no road access				
6-7	3	0.0	0.0	0
8-10	39	0.6	0.6	100
11-14	305	1.4	1.5	93
Code 5 - no road and air access				
6-7	5	0.4	0.6	67
8-10	50	0.5	0.6	83
11-14	319	1.2	1.3	92

Appendix 12 CRIES STATUS BY ACCESS
% OF MEAN dt/MEAN dmft

Age (yrs)	N	dt	dmft	% dt/dmft
Code 1 - highway access				
6-7	23	2.4	2.5	96
8-10	346	1.7	1.8	94
Code 2 - main road access				
6-7	9	3.3	3.3	100
8-10	447	1.4	1.4	100
Code 3 - access road access				
6-7	11	2.7	2.7	100
8-10	380	1.7	1.8	94
Code 4 - no road access				
6-7	3	0.3	0.7	43
8-10	39	0.9	0.9	100
Code 5 - no road and air access				
6-7	5	1.2	1.4	86
8-10	50	0.8	0.8	100

Appendix 13 CARRIES STATUS BY ALTITUDE
 % OF MEAN DT/MEAN DMFT and
 % OF MEAN dt/MEAN dmft

Age (yrs)	N	DT	DMFT	% DT/DMFT
Code 1 - < 1500 m				
6-7	7	0.7	0.9	78
8-10	197	0.5	0.5	100
11-14	1019	1.2	1.5	80
Code 2 - 1501 - 1900 m				
6-7	36	0.6	0.7	86
8-10	872	0.7	0.8	88
11-14	2315	1.1	1.5	73
Code 3 - > 1900 m				
6-7	8	0.9	1.1	82
8-10	194	0.6	0.7	86
11-14	670	1.4	1.8	78

Age (yrs)	N	dt	dmft	%dt/dmft
Code 1 - < 1500 m				
6-7	7	1.4	1.6	88
8-10	197	1.1	1.1	100
Code 2 - 1501-1900 m				
6-7	36	2.4	2.5	96
8-10	872	1.5	1.6	94
Code 3 - > 1900 m				
6-7	8	3.0	3.3	91
8-10	194	1.8	1.8	100

Appendix 14 **CARIES STATUS BY AGE**
MEAN NUMBERS OF FT AND ft WITH PRIMARY DECAY, AND
MEAN NUMBERS OF FT AND ft WITH SECONDARY DECAY

Age (yrs)	N	FT with primary decay	FT with secondary decay
6-7	51	0.0	0.0
8-10	1263	0.0	0.0
11-14	4006	0.0	0.0

Age (yrs)	N	ft with primary decay	ft with secondary decay
6-7	51	0.0	0.0
8-10	1263	0.0	0.0

Appendix 15 MEAN NUMBER OF PERMANENT TEETH MISSING DUE
OTHER THAN CARIES - BY AGE
MEAN NUMBER OF PRIMARY TEETH PREMATURELY MISSING
DUE ANY REASON - BY AGE

Permanent teeth

Age (yrs)	N	Mean number of teeth missing
6-7	51	0.0
8-10	1263	0.0
11-14	4006	0.0

Primary teeth

Age (yrs)	N	Mean number of teeth missing
6-7	51	0.1
8-10	1263	0.1

Appendix 16 CRIES TREATMENT NEEDS BY ACCESS - RESTORATIVE CARE - PERMANENT DENTITION - 11-14 YEARS
NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING CARE

Access	N	No treatment		1 surface restoration		2 surface restoration		3 surface restoration		>3 surface restoration or crown						
		No.	%	Mean	No.	%	Mean	No.	%	No.	%	Mean				
Code 1 - highway access	544	275	50.6	25.5	204	37.5	0.7	69	12.7	0.2	29	5.3	0.1	5	0.9	0.0
Code 2 - main road access	1363	642	47.1	25.7	604	44.3	0.8	183	13.4	0.2	63	4.6	0.1	8	0.4	0.0
Code 3 - access road access	1472	731	49.7	25.8	594	40.4	0.7	191	13.0	0.2	66	4.5	0.1	6	0.4	0.0
Code 4 - no road access	305	139	45.6	26.1	143	46.9	1.0	34	11.1	0.1	14	4.6	0.1	2	0.7	0.0
Code 5 - no road and air access	319	148	46.4	26.1	128	40.1	0.6	41	12.9	0.2	15	4.7	0.1	3	0.9	0.0

Appendix 17 CRIES TREATMENT NEEDS BY ACCESS - TEETH REQUIRING EXTRACTIONS - PERMANENT DENTITION
- 11-14 YEARS NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING EXTRACTIONS

Access	N	Caries		Periodontal disease		Other reasons				
		No.	% Mean	No.	% Mean	No.	% Mean			
Code 1 - highway access	544	87	16	0.2	0	0.0	0.0	3	0.6	0.0
Code 2 - main road access	1363	154	11.3	0.2	0	0.0	0.0	4	0.3	0.0
Code 3 - access road access	1472	199	13.5	0.2	2	0.1	0.0	3	0.2	0.0
Code 4 - no road access	305	43	14.1	0.2	0	0.0	0.0	2	0.7	0.0
Code 5 - no road and air access	319	62	19.4	0.3	1	0.3	0.0	0	0.0	0.0

Appendix 18 CRIES TREATMENT NEEDS BY ACCESS - RESTORATIVE CARE - PERMANENT DENTITION - 8-10 YEARS
NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING CARE

Access	N	No treatment		1 surface restoration		2 surface restoration		3 surface restoration		3 surface restoration		> 3 surface restoration	
		No.	%	Mean	%	No.	%	Mean	%	No.	%	Mean	No. or crown
Code 1 - highway access	346	229	66.2	15.4	81	23.4	0.4	37	10.7	0.1	14	4.0	3 0.9 0.0
Code 2 - main road access	447	295	66.0	16.1	110	24.6	0.4	47	10.5	0.1	12	2.7	1 0.2 0.0
Code 3 - access road access	380	237	62.4	16.7	114	30.0	0.4	32	8.4	0.1	12	3.2	0 0.0 0.0
Code 4 - no road access	39	24	61.5	15.8	11	28.2	0.4	3	7.7	0.1	1	2.6	0 0.0 0.0
Code 5 - no road and air access	50	33	66.0	17.8	12	24.0	0.3	3	6.0	0.1	0	0.0	0 0.0 0.0

Appendix 19 CRIES TREATMENT NEEDS BY ACCESS - TEETH REQUIRING EXTRACTIIONS - PERMANENT DENTITION
- 8-10 YEARS NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING EXTRACTIIONS

Access	N	Caries		Periodontal disease		Other reasons	
		No.	%	No.	%	No.	%
Code 1 - highway access	346	24	6.9	0.1	0.0	0.0	0.0
Code 2 - main road access	447	29	6.5	0.1	0.0	0.0	0.0
Code 3 - access road access	380	11	2.9	0.0	0.0	0.0	0.0
Code 4 - no road access	39	3	7.7	0.1	0.0	0.0	0.0
Code 5 - no road and air access	50	6	12.0	0.1	0.0	0.0	0.0

Appendix 20 CRIES TREATMENT NEEDS BY ACCESS - RESTORATIVE CARE AND TEETH REQUIRING EXTRACTIONS FOR CARIES - PRIMARY DENTITION -
8-10 YEARS
NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING CARE AND EXTRACTIONS

Access	N	No treatment			1 surface restoration			2 surface restoration			3 surface restoration			Extraction for caries		
		No.	%	Mean	No.	%	Mean	No.	%	Mean	No.	%	Mean	No.	%	Mean
Code 1 - highway access	346	323	93.4	7.6	1	0.3	0.0	0	0.0	0.0	0	0.0	0.0	22	6.4	0.1
Code 2 - main road access	447	407	91.1	6.9	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	40	8.9	0.1
Code 3 - access road access	380	356	93.7	6.5	0	0.0	0.0	1	0.3	0.0	0	0.0	0.0	23	6.1	0.1
Code 4 - no road access	39	37	94.9	7.5	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	2	5.1	0.1
Code 5 - no road and air access	50	49	98.0	5.7	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	1	2.0	0.0

Appendix 21 CRIES TREATMENT NEEDS BY ALTITUDE -- RESTORATIVE CARE AND TEETH REQUIRING EXTRACTIONS - PERMANENT DENTITION
 11-14 YEARS
 NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING CARE

Altitude	N	No treatment		1 surface restoration		2 surface restoration		3 surface restoration		> 3 surface restoration						
		No.	%	Mean	No.	%	Mean	No.	%	Mean	No.	%	Mean			
Code 1 - < 1500 m	1019	486	47.7	26.0	430	42.2	0.8	123	12.1	0.1	47	4.6	0.1	8	0.8	0.0
Code 2 - 1501 - 1900 m	2315	1147	49.5	25.7	960	41.5	0.7	290	12.5	0.2	97	4.2	0.1	8	0.3	0.0
Code 3 - > 1900 m	670	303	45.2	25.7	282	42.1	0.7	104	15.5	0.2	43	6.4	0.1	8	1.2	0.0

Number and % of persons, and mean number of the teeth requiring extractions

Altitude code	N	Caries		Periodontal disease		Other Reasons	
		No.	%	Mean	No.	%	Mean
Code 1 - < 1500 m	1019	154	15.1	0.1	2	0.2	0.0
Code 2 - 1501 - 1900 m	2315	267	11.5	0.2	0	0.0	0.0
Code 3 - > 1900 m	670	125	18.7	0.3	1	0.1	0.0

Appendix 22 CRIES TREATMENT NEEDS BY ALTITUDE - RESTORATIVE CARE AND TEETH REQUIRING EXTRACTIONS - PERMANENT DENTITION
8-10 YEARS
NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING CARE

Altitude	N	No treatment		1 surface restoration		2 surface restoration		3 surface restoration		> 3 surface restoration or crown						
		No.	% Mean	No.	% Mean	No.	% Mean	No.	% Mean	No.	% Mean					
Code 1 - < 1500 m	197	132	67.0	17.1	46	23.4	0.3	11	5.6	0.1	1	0.5	0.0			
Code 2 - 1501 - 1900 m	872	567	65.0	15.8	230	26.4	0.4	92	10.6	0.1	31	3.6	0.1	0.2	0.0	
Code 3 - > 1900 m	194	120	61.9	16.9	52	26.8	0.4	19	9.8	0.1	7	3.6	0.0	1	0.5	0.0

Number and % of persons, and mean number of the teeth requiring extractions

Altitude code	N	Caries		Periodontal disease		Other Reasons				
		No.	%	Mean	No.	%	Mean			
Code 1 - < 1500 m	197	16	8.1	0.1	0	0.0	0.0	1	0.5	0.0
Code 2 - 1501 - 1900 m	872	47	5.4	0.1	0	0.0	0.0	4	0.5	0.0
Code 3 - > 1900 m	194	10	5.2	0.1	0	0.0	0.0	0	0.0	0.0

Appendix 23 CRIES TREATMENT NEEDS BY ALTITUDE -- RESTORATIVE CARE AND TEETH REQUIRING EXTRACTIONS FOR CARIES --
PRIMARY DENTITION 8-10 YEARS
NUMBER AND % OF PERSONS, AND MEAN NUMBER OF TEETH REQUIRING CARE AND EXTRACTIONS

Altitude	N	No treatment		1 surface restoration			2 surface restoration			3 surface restoration			Extraction for caries			
		No.	%	Mean	No.	%	Mean	No.	%	Mean	No.	%	Mean	No.	%	Mean
Code 1 - < 1500 m	197	183	92.9	6.3	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	14	7.1	0.1
Code 2 - 1501 - 1900	872	810	92.9	7.2	1	0.1	0.0	1	0.1	0.0	0	0.0	0.0	60	6.9	0.1
Code 3 - > 1900 m	194	180	92.8	6.3	0	0.0	0.0	0	0.0	0.0	0	0.0	0.0	14	7.2	0.1

Appendix 24 PERIODONTAL STATUS (CPITN) BY ACCESS

% of persons affected by worst severity score

Age (Yrs)	N	no periodontal disease 0	% of persons with bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
Code 1 - highway access						
6-7	24	4	33	63	0	0
8-10	346	3	18	79	0	0
11-14	548	2	8	90	0	0
Code 2 - main road access						
6-7	9	0	89	11	0	0
8-10	450	1	18	81	0	0
11-14	1371	1	12	86	(0.4)	(0.2)
Code 3 - access road access						
6-7	11	9	36	55	0	0
8-10	380	1	20	79	0	0
11-14	1476	1	7	92	(0.2)	0
Code 4 - no road access						
6-7	3	0	67	33	0	0
8-10	41	10	22	68	0	0
11-14	305	2	8	90	0	0
Code 5 - no road and air access						
6-7	5	0	20	80	0	0
8-10	50	2	2	96	0	0
11-14	321	0	4	94	1	1

Appendix 25 PERIODONTAL STATUS (CPITN) BY ACCESS

Mean number of sextants affected

Age (Yrs)	N	mean number of sextants with				
		no periodontal	bleeding	calculus	shallow	deep
		disease	only		pockets	pockets
		0	1	2	3	4
Code 1 - highway access						
6-7	24	3.1	1.3	1.6	0	0
8-10	346	2.3	1.4	2.3	0	0
11-14	548	2.2	1.3	2.5	0	0
Code 2 - main road access						
6-7	9	2.4	3.5	0.1	0	0
8-10	450	1.8	2.1	2.1	0	0
11-14	1371	1.7	1.9	2.4	0	0
Code 3 - access road access						
6-7	11	3.0	1.4	1.6	0	0
8-10	380	2.1	1.9	2.0	0	0
11-14	1476	1.8	1.4	2.8	0	0
Code 4 - no road access						
6-7	3	4.3	0.7	1.0	0	0
8-10	41	3.3	1.1	1.6	0	0
11-14	305	2.4	1.1	2.5	0	0
Code 5 - no road and air access						
6-7	5	2.6	1.0	2.4	0	0
8-10	50	1.9	0.8	3.3	0	0
11-14	321	1.5	0.8	3.7	0	0

Appendix 26 PERIODONTAL STATUS (CPITN) BY ACCESS

Treatment needs - % of persons and mean number of sextants

Age (Yrs)	N	oral hygiene instruction	prophylaxis	complex care		
		TNI	TN2	TN3		
		%	%	MNS	%	MNS
Code 1 - highway access						
6-7	24	96	63	1.6	0	0
8-10	346	97	79	2.3	0	0
11-14	548	98	90	2.5	0	0
Code 2 - main road access						
6-7	9	100	11	0.1	0	0
8-10	450	99	81	2.1	0	0
11-14	1371	99	86	2.4	0	0
Code 3 - access road access						
6-7	11	91	55	1.6	0	0
8-10	380	99	79	2.0	0	0
11-14	1476	99	93	2.8	0	0
Code 4 - no road access						
6-7	3	100	33	1.0	0	0
8-10	41	90	68	1.6	0	0
11-14	305	98	90	2.5	0	0
Code 5 - no road and air access						
6-7	5	100	80	2.4	0	0
8-10	50	98	96	3.3	0	0
11-14	321	100	96	3.7	0	0

Appendix 27 PERIODONTAL STATUS (CPITN) BY ALTITUDE

% of persons affected by worst severity score

Age (Yrs)	N	no periodontal disease 0	% of persons with bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
Code 1 - < 1500 m						
6-7	7	0	43	57	0	0
8-10	197	4	14	82	0	0
11-14	1022	2	10	88	(0.4)	(0.2)
Code 2 - 1501 - 1900 m						
6-7	37	5	35	60	0	0
8-10	875	2	19	79	0	0
11-14	2325	1	9	90	(0.4)	(0.1)
Code 3 - > 1900 m						
6-7	8	0	88	13	0	0
8-10	195	2	17	82	0	0
11-14	676	1	7	92	(0.1)	0

Appendix 28 PERIODONTAL STATUS (CPITN) BY ALTITUDE

Mean number of sextants affected

Age (Yrs)	N	mean number of sextants with				
		no periodontal	bleeding	calculus	shallow	deep
		disease 0	only 1	2	pockets 3	pockets 4
Code 1 - < 1500 m						
6-7	7	2.9	1.4	1.7	0	0
8-10	197	2.3	1.5	2.2	0	0
11-14	1022	1.9	1.4	2.7	0	0
Code 2 - 1501 - 1900 m						
6-7	37	2.9	1.6	1.5	0	0
8-10	875	2.0	1.9	2.1	0	0
11-14	2325	1.8	1.6	2.6	0	0
Code 3 - > 1900 m						
6-7	8	3.4	2.2	0.4	0	0
8-10	195	2.1	1.8	2.1	0	0
11-14	674	2.0	1.3	2.7	0	0

Appendix 29 PERIODONTAL STATUS (CPITN) BY ALTITUDE

Treatment needs - % of persons and mean number of sextants

Age (Yrs)	N	oral hygiene instruction	prophylaxis	complex care		
		TN1	TN2	TN3		
		%	%	MNS	%	MNS
Code 1 - < 1500 m						
6-7	7	100	57	1.7	0	0
8-10	197	96	82	2.2	0	0
11-14	1022	98	89	2.7	0	0
Code 2 - 1501 - 1900 m						
6-7	37	95	59	1.5	0	0
8-10	875	98	79	2.1	0	0
11-14	2325	99	90	2.6	0	0
Code 3 - > 1900 m						
6-7	8	100	13	0.4	0	0
8-10	195	98	82	2.1	0	0
11-14	674	99	92	2.7	0	0

Appendix 30 PERIODONTAL STATUS (CPITN) BY SCHOOL
% OF PERSONS WITH WORST SEVERITY SCORE 11-14 YEARS

School code	School	no perio- dental disease		% of persons with			
		N	0	bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
1	Koinambe	95	2	6	91	1	
2	Mt Au	72	0	6	94	0	0
3	Tsikisa	43	0	5	95	0	0
4	Kwinkya	121	2	12	85	1	0
5	Tapiakama	60	0	0	95	5	0
6	Kingaringa	69	0	0	100	0	0
7	Lumis	108	1	9	89	1	0
8	Gobo	76	0	0	100	0	0
9	Ambullua	138	3	10	87	0	0
10	Tabibuga	110	7	11	82	0	0
11	Togban	104	0	12	86	1	2
12	Paraka	27	0	22	78	0	0
13	Alimp	56	0	0	100	0	0
14	Nebilyer	86	0	12	88	0	0
15	Kuga	117	1	8	92	0	0
16	Fatima	100	0	3	97	0	0
17	St Anselm	62	0	6	92	2	0
18	Nondugal St Marys	89	0	9	88	1	2
19	Ambang	81	0	6	94	0	0
20	Millep	85	0	0	100	0	0
21	St John Bosco	79	9	18	73	0	0
22	Kugark	72	0	4	96	0	0
23	Kurumul	97	0	9	90	1	0
24	Piltange	98	0	1	98	1	0
25	Dama	29	0	7	93	0	0
26	Muglamp	104	1	10	89	0	0
27	Nunga	109	1	15	84	0	0
28	Golge	62	0	2	98	0	0
29	Kindeng	14	7	7	86	0	0
30	Kuli	99	1	5	94	0	0
31	Kaip	80	5	10	85	0	0
33	Arawagai	178	1	11	88	0	0
34	Rebiamul	133	1	0	99	0	0
35	Kokglamp	122	1	34	64	1	0
36	Mt Hagen	64	0	12	87	1	0
37	Anga	63	0	10	90	0	0
38	Minimp	15	0	0	100	0	0
39	Malbuga	101	3	30	66	1	0
40	Kelengha	102	3	16	81	0	0
41	Bukapena	89	2	17	81	0	0
42	Tambul	120	0	0	100	0	0
43	Yano	93	0	9	90	1	0
44	Tomba	25	0	12	88	0	0
45	Alkena	87	0	0	100	0	0
46	Kiripia	52	2	17	81	0	0
47	Kosap	81	0	0	100	0	0
48	Tsingaropa	48	0	0	100	0	0
49	Ulga	73	0	1	99	0	0
50	Holy Trinity	32	3	6	91	0	0

Appendix 31 PERIODONTAL STATUS (CPITN) BY SCHOOL
MEAN NUMBER OF SEXTANTS AFFECTED 11-14 YEARS

School code	School	N	mean number of sextants with				
			no perio- dental disease 0	bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
1	Koinambe	95	2.2	1.1	2.7	0	0
2	Mt Au	72	2.0	1.1	2.9	0	0
3	Tsikisa	43	0.8	2.3	2.9	0	0
4	Kwinkya	121	2.4	1.6	2.0	0	0
5	Tapiakama	60	1.9	0.2	3.8	0.1	0
6	Kingaringa	69	1.8	0.5	3.7	0	0
7	Lumis	108	2.4	1.1	2.5	0	0
8	Gobo	76	1.4	0.2	4.4	0	0
9	Ambullua	138	2.7	1.1	2.2	0	0
10	Tabibuga	110	2.9	1.1	2.0	0	0
11	Togban	104	1.7	1.9	2.4	0	0
12	Paraka	27	2.2	1.5	2.3	0	0
13	Alimp	56	0.7	1.8	3.5	0	0
14	Nebilyer	86	2.0	1.9	2.1	0	0
15	Kuga	117	1.8	1.8	2.4	0	0
16	Fatima	100	1.2	1.6	3.2	0	0
17	St Anselm	62	1.3	1.4	3.3	0	0
18	Nondugal St Marys	89	1.2	1.6	3.2	0	0
19	Ambang	81	1.5	1.6	2.9	0	0
20	Millep	85	1.1	1.6	3.3	0	0
21	St John Bosco	79	3.2	1.2	1.6	0	0
22	Kugark	72	0.7	2.2	3.1	0	0
23	Kurumul	97	1.2	2.2	2.6	0	0
24	Piltange	98	1.0	1.6	3.4	0	0
25	Dama	29	1.9	1.6	2.5	0	0
26	Muglamp	104	2.2	1.9	1.9	0	0
27	Nunga	109	2.3	1.6	2.1	0	0
28	Golge	62	1.3	0.5	4.2	0	0
29	Kindeng	14	2.9	1.0	2.1	0	0
30	Kuli	99	2.1	1.4	2.5	0	0
31	Kaip	80	2.4	1.5	2.1	0	0
33	Arawagai	178	2.5	1.4	2.1	0	0
34	Rebiamul	133	2.1	0.3	3.6	0	0
35	Kokglamp	122	1.5	3.3	1.2	0	0
36	Mt Hagen	64	1.8	1.8	2.4	0	0
37	Anga	63	0.8	2.4	2.8	0	0
38	Minimp	15	1.7	1.2	3.1	0	0
39	Malbuga	101	1.5	3.2	1.3	0	0
40	Kelengha	102	2.9	1.5	1.6	0	0
41	Bukapena	89	2.0	2.1	1.9	0	0
42	Tambul	120	1.4	0.8	3.8	0	0
43	Yano	93	2.1	1.5	2.4	0	0
44	Tomba	25	2.6	1.8	1.6	0	0
45	Alkena	87	1.8	0.6	3.6	0	0
46	Kiripia	52	2.3	1.9	1.8	0	0
47	Kosap	81	1.3	0.2	4.5	0	0
48	Tsingaropa	48	1.7	0.1	4.2	0	0
49	Ulga	73	2.0	0.5	3.5	0	0
50	Holy Trinity	32	2.7	1.0	2.3	0	0

Appendix 32 PERIODONTAL STATUS (CPITN) BY SCHOOL
TREATMENT NEEDS % OF PERSONS AND MEAN NUMBER OF SEXTANTS
11-14 YEARS

School code	School	N	oral hygiene instruction	prophylaxis		complex care	
			TN1 %	%	TN2 MNS	%	TN3 MNS
1	Koinambe	95	98	92	2.7	0	0.0
2	Mt Au	72	100	94	2.9	0	0.0
3	Tsikisa	43	100	95	2.9	0	0.0
4	Kwinkya	121	98	86	2.0	0	0.0
5	Tapiakama	60	100	100	3.8	0	0.0
6	Kingaringa	69	100	100	3.7	0	0.0
7	Lumis	108	99	90	2.5	0	0.0
8	Gobo	76	100	100	4.4	0	0.0
9	Ambullua	138	97	87	2.2	0	0.0
10	Tabibuga	110	93	82	2.0	0	0.0
11	Togban	104	100	88	2.4	0	0.0
12	Paraka	27	100	78	2.3	0	0.0
13	Alimp	56	100	100	3.5	0	0.0
14	Nebilyer	86	100	88	2.1	0	0.0
15	Kuga	117	99	91	2.4	0	0.0
16	Fatima	100	100	97	3.2	0	0.0
17	St Anselm	62	100	94	3.3	0	0.0
18	Nondugal St Marys	89	100	91	3.2	0	0.0
19	Ambang	81	100	94	2.9	0	0.0
20	Millep	85	100	100	3.3	0	0.0
21	St John Bosco	79	91	73	1.6	0	0.0
22	Kugark	72	100	96	3.1	0	0.0
23	Kurumul	97	100	91	2.6	0	0.0
24	Piltange	98	100	99	3.4	0	0.0
25	Dama	29	100	93	2.5	0	0.0
26	Muglamp	104	99	89	1.9	0	0.0
27	Nunga	109	99	84	2.1	0	0.0
28	Golge	62	100	98	4.2	0	0.0
29	Kindeng	14	93	86	2.1	0	0.0
30	Kuli	99	99	94	2.5	0	0.0
31	Kaip	80	95	85	2.1	0	0.0
33	Arawagai	178	99	88	2.1	0	0.0
34	Rebiamul	133	99	99	3.6	0	0.0
35	Kokglamp	122	99	65	1.2	0	0.0
36	Mt Hagen	64	100	89	2.4	0	0.0
37	Anga	63	100	90	2.8	0	0.0
38	Minimp	15	100	100	3.1	0	0.0
39	Malbuga	101	97	67	1.3	0	0.0
40	Kelengha	102	98	81	1.6	0	0.0
41	Bukapena	89	98	81	1.9	0	0.0
42	Tambul	120	100	100	3.8	0	0.0
43	Yano	93	100	91	2.4	0	0.0
44	Tomba	25	100	88	1.6	0	0.0
45	Alkena	87	100	100	3.6	0	0.0
46	Kiripia	52	98	81	1.8	0	0.0
47	Kosap	81	100	100	4.5	0	0.0
48	Tsingaropa	48	100	100	4.2	0	0.0
49	Ulga	73	100	99	3.5	0	0.0
50	Holy Trinity	32	97	91	2.3	0	0.0

Appendix 33 PERIODONTAL STATUS - SCHOOL BY ACCESS AND ALTITUDE
MEAN NUMBER OF SEXTANTS AFFECTED
11-14 YEARS

School code	School	N	Access code	Altitude code	mean number of no perio- disease	perio- disease	bleeding only	cal -culus
1	Koinambe	95	4	1	2.2	3.8	1.1	2.7
2	Mt Au	72	4	1	2.0	4.0	1.1	2.9
3	Tsikisa	43	3	1	0.8	5.2	2.3	2.9
4	Kwinkya	121	2	1	2.4	3.6	1.6	2.0
5	Tapiakama	60	5	2	1.9	4.1	0.2	3.8
6	Kingaringa	69	3	3	1.8	4.2	0.5	3.7
7	Lumis	108	3	2	2.4	3.6	1.1	2.5
8	Gobo	76	5	1	1.4	4.6	0.2	4.4
9	Ambullua	138	4	3	2.7	3.3	1.1	2.2
10	Tabibuga	110	2	1	2.9	3.1	1.1	2.0
11	Togban	104	5	1	1.7	4.3	1.9	2.4
12	Paraka	27	3	1	2.2	3.8	1.5	2.3
13	Alimp	56	3	1	0.7	5.3	1.8	3.5
14	Nebilyer	86	1	1	2.0	4.0	1.9	2.1
15	Kuga	117	1	2	1.8	4.2	1.8	2.4
16	Fatima	100	2	2	1.2	4.8	1.6	3.2
17	St Anselm	62	2	2	1.3	4.7	1.4	3.3
18	Nondugal St Marys	89	2	2	1.2	4.8	1.6	3.2
19	Ambang	81	3	2	1.5	4.5	1.6	2.9
20	Millep	85	3	2	1.1	4.9	1.6	3.3
21	St John Bosco	79	1	2	3.2	2.8	1.2	1.6
22	Kugark	72	2	2	0.7	5.3	2.2	3.1
23	Kurumul	97	2	2	1.2	4.8	2.2	2.6
24	Piltange	98	3	2	1.0	5.0	1.6	3.4
25	Dama	29	3	2	1.9	4.1	1.6	2.5
26	Muglamp	104	2	2	2.2	3.8	1.9	1.9
27	Nunga	109	2	2	2.3	3.7	1.6	2.1
28	Golge	62	3	2	1.3	4.7	0.5	4.2
29	Kindeng	14	1	2	2.9	3.1	1.0	2.1
30	Kuli	99	3	2	2.1	3.9	1.4	2.5
31	Kaip	80	3	2	2.4	3.6	1.5	2.1
33	Arawagai	178	3	2	2.5	3.5	1.4	2.1
34	Rebiamul	133	1	2	2.1	3.9	0.3	3.6
35	Kokglamp	122	2	2	1.5	4.5	3.3	1.2
36	Mt Hagen	64	1	2	1.8	4.2	1.8	2.4
37	Anga	63	3	2	0.8	5.2	2.4	2.8
38	Minimp	15	3	2	1.7	4.3	1.2	3.1
39	Malbuga	101	2	1	1.5	4.5	3.2	1.3
40	Kelengha	102	3	2	2.9	3.1	1.5	1.6
41	Bukapena	89	2	3	2.0	4.0	2.1	1.9
42	Tambul	120	2	3	1.4	4.6	0.8	3.8
43	Yano	93	3	3	2.1	3.9	1.5	2.4
44	Tomba	25	1	3	2.6	3.4	1.8	1.6
45	Alkena	87	3	3	1.8	4.2	0.6	3.6
46	Kiripia	52	3	3	2.3	3.7	1.9	1.8
47	Kosap	81	5	1	1.3	4.7	0.2	4.5
48	Tsingaropa	48	3	1	1.7	4.3	0.1	4.2
49	Ulga	73	2	2	2.0	4.0	0.5	3.5
50	Holy Trinity	32	1	2	2.7	3.3	1.0	2.3

Appendix 34 PERIODONTAL STATUS (CPITN) BY SCHOOL
 % OF PERSONS AFFECTED BY WORST SEVERITY SCORE
 8-10 YEARS

School code	School	N	no perio- dental disease 0	% of persons with			
				bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
10	Tabibuga	31	7	29	64	0	0
14	Nebilyer	32	0	22	78	0	0
16	Fatima	38	0	8	92	0	0
17	St Anselm	66	0	14	86	0	0
19	Ambang	37	0	16	84	0	0
21	St John						
	Bosco	40	10	30	60	0	0
22	Kugark	48	0	6	94	0	0
23	Kurumul	31	0	32	68	0	0
26	Muglamp	34	3	26	71	0	0
30	Kuli	51	0	31	69	0	0
34	Rebiamul	153	1	3	96	0	0
37	Anga	36	0	11	89	0	0
42	Tambul	58	0	3	97	0	0
46	Kiripia	48	2	27	71	0	0
50	Holy Trinity	68	3	32	65	0	0

Appendix 35 PERIODONTAL STATUS (CPITN) BY SCHOOL
MEAN NUMBER OF SEXTANTS AFFECTED
8-10 YEARS

School code	School	N	no perio- dental disease 0	mean number of sextants with			
				bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
10	Tabibuga	31	2.9	1.7	1.4	0	0
14	Nebilyer	32	2.3	1.8	1.9	0	0
16	Fatima	38	1.2	2.3	2.5	0	0
17	St Anselm	66	1.2	2.2	2.6	0	0
19	Ambang	37	2.1	1.7	2.2	0	0
21	St John						
	Bosco	40	3.5	1.5	1.0	0	0
22	Kugark	48	0.8	2.7	2.5	0	0
23	Kurumul	31	1.6	2.9	1.5	0	0
26	Muglamp	34	2.4	2.4	1.2	0	0
30	Kuli	51	2.2	2.3	1.5	0	0
34	Rebiamul	153	2.1	0.6	3.3	0	0
37	Anga	36	1.2	2.7	2.1	0	0
42	Tambul	58	1.9	1.3	2.8	0	0
46	Kiripia	48	2.3	2.0	1.7	0	0
50	Holy Trinity	68	2.7	1.9	1.4	0	0

Appendix 36 PERIODONTAL STATUS (CPITN) BY SCHOOL
TREATMENT NEEDS - % OF PERSONS AND MEAN NUMBER OF
SEXTANTS
8-10 YEARS

School code	School	N	oral hygiene	prophylaxis		complex care	
			TN1 %	%	TN2 MNS	%	TN3 MNS
10	Tabibuga	31	94	65	1.4	0	0.0
14	Nebilyer	32	100	78	1.9	0	0.0
16	Fatima	38	100	92	2.5	0	0.0
17	St Anselm	66	100	86	2.6	0	0.0
19	Ambang	37	100	84	2.2	0	0.0
21	St John						
	Bosco	40	90	60	1.0	0	0.0
22	Kugark	48	100	94	2.5	0	0.0
23	Kurumul	31	100	68	1.5	0	0.0
26	Muglamp	34	97	71	1.2	0	0.0
30	Kuli	51	100	69	1.5	0	0.0
34	Rebiamul	153	99	96	3.3	0	0.0
37	Anga	36	100	89	2.1	0	0.0
42	Tambul	58	100	97	2.8	0	0.0
46	Kiripia	48	98	71	1.7	0	0.0
50	Holy Trinity	68	97	65	1.4	0	0.0

Appendix 37 PERIODONTAL STATUS - ACCESS BY ALTITUDE
% OF PERSONS AFFECTED BY WORST SEVERITY SCORE
8-10 YEARS AND 11-14 YEARS

Access code 1 - highway access Altitude code 1 < 1500 m
 2 - mainroad access 2 1501-1900 m
 3 - access road access 3 > 1901 m
 4 - no road access
 5 - no road and air access

Age (yrs)	N	% of persons with				
		no periodontal disease 0	bleeding only 1	calculus 2	shallow pockets 3	deep pockets 4
Code 1-1 - highway access: < 1500 m						
8-10	33	0	21	79	0	0
11-14	86	0	12	88	0	0
Code 1-2 - highway access: 1501-1900 m						
8-10	299	3	16	81	0	0
11-14	437	2	8	90	0	0
Code 1-3 - highway access: >1900 m						
8-10	14	0	50	50	0	0
11-14	25	0	12	88	0	0
Code 2-1 - main road access: < 1500 m						
8-10	67	8	22	70	0	0
11-14	333	4	17	78	1	0
Code 2-2 - main road access: 1501- 1900 m						
8-10	296	0	20	80	0	0
11-14	829	0	12	87	0	0
Code 2-3 - main road access: > 1900 m						
8-10	87	0	8	92	0	0
11-14	209	1	7	92	0	0
Code 3-1 - access road access: < 1500 m						
8-10	31	0	3	97	0	0
11-14	175	0	5	95	0	0
Code 3-2 - access road access: 1501-1900 m						
8-10	275	2	22	77	0	0
11-14	999	1	7	91	0	0
Code 3-3 - access road access: > 1900 m						
8-10	74	1	19	80	0	0
11-14	302	0	6	94	0	0
Code 4-1 - no road access: < 1500 m						
8-10	21	10	19	71	0	0
11-14	167	1	6	92	1	0
Code 4-3 - no road access: 1501-1900 m						
8-10	20	10	25	65	0	0
11-14	138	3	10	87	0	0
Code 5-1 - no road and air access: < 1500 m						
8-10	45	2	2	96	0	0
11-14	261	0	5	94	0	1
Code 5-2 - no road and air access: 1501-1900 m						
8-10	5	0	0	100	0	0
11-14	60	0	0	95	5	0

Appendix 38 **FLUOROSIS BY ACCESS**
NUMBER AND % OF PERSONS AFFECTED

Age (yrs)	N	Normal N	Questionable Q	Fluorosis			
				Very Mild VM	Mild M	Moderate MO	Severe S
Code 1 - highway access							
6-7	24	23	1	0	0	0	0
8-10	346	295	48	2	2	1	0
11-14	548	451	77	13	4	3	0
Total	918	769	126	15	4	4	0
%	100	84	14	2	0	0	0
Code 2 - main road access							
6-7	9	8	1	0	0	0	0
8-10	450	397	47	2	1	3	0
11-14	1371	1144	189	24	12	2	0
Total	1830	1549	237	26	13	5	0
%	100	85	13	2	1	0	0
Code 3 - access road access							
6-7	11	10	1	0	0	0	0
8-10	380	340	28	7	5	0	0
11-14	1476	1229	184	42	17	4	0
Total	1867	1579	213	49	22	4	0
%	100	85	11	3	1	0	0
Code 4 - no road access							
6-7	3	3	0	0	0	0	0
8-10	41	36	3	1	1	0	0
11-14	305	264	34	5	1	1	0
Total	349	303	37	6	2	1	0
%	100	87	11	2	1	0	0
Code 5 - no road and air access							
6-7	5	5	0	0	0	0	0
8-10	50	45	3	1	0	1	0
11-14	321	283	34	2	2	0	0
Total	376	333	37	3	2	1	0
%	100	89	10	1	1	0	0

Appendix 39 FLUOROSIS BY ALTITUDE
NUMBER AND % OF PERSONS AFFECTED

Age (yrs)	N	Normal N	Questionable Q	Fluorosis Very Mild VM	Mild M	Moderate MO	Severe S
Code 1 - < 1500m							
6-7	7	7	0	0	0	0	0
8-10	197	178	14	4	1	0	0
11-14	1022	892	108	13	8	1	0
Total	1226	1077	122	17	9	1	0
%	100	88	10	1	1	0	0
Code 2 - 1501-1900m							
6-7	37	35	2	0	0	0	0
8-10	875	773	86	6	5	5	0
11-14	2325	1929	315	52	20	9	0
Total	3237	2737	403	58	25	14	0
%	100	85	13	2	1	0	0
Code 3 - > 1900m							
6-7	8	7	1	0	0	0	0
8-10	195	162	29	3	1	0	0
11-14	674	550	95	21	8	0	0
Total	877	719	125	24	9	0	0
%	100	82	14	3	1	0	0

Appendix 40 FLUOROSIS BY SCHOOL
NUMBER OF PERSONS AFFECTED 11-14 YEARS

School code	School	N	Normal	Quest- ionable	Very Mild	Mild	Moderate	Severe
			N	Q	VM	M	Mo	S
1	Koinambe	95	88	6	0	1	0	0
2	Mt Au	72	48	19	4	0	1	0
3	Tsikisa	43	41	1	0	1	0	0
4	Kwinkya	121	111	5	3	2	0	0
5	Tapiakama	60	52	7	0	1	0	0
6	Kingaringa	69	58	8	2	1	0	0
7	Lumis	108	89	16	3	0	0	0
8	Gobo	76	66	10	0	0	0	0
9	Ambullua	138	128	9	1	0	0	0
10	Tabibuga	110	100	9	1	0	0	0
11	Togban	104	98	5	1	0	0	0
12	Paraka	27	22	5	0	0	0	0
13	Alimp	56	53	3	0	0	0	0
14	Nebilyer	86	74	12	0	0	0	0
15	Kuga	117	88	21	4	3	1	0
16	Fatima	100	96	4	0	0	0	0
17	St Anselm	62	59	3	0	0	0	0
18	Nondugal St Marys	89	62	25	0	2	0	0
19	Ambang	81	56	25	0	0	0	0
20	Millep	85	84	1	0	0	0	0
21	St John Bosco	79	59	14	4	1	1	0
22	Kugark	72	62	6	1	1	2	0
23	Kurumul	97	63	26	5	3	0	0
24	Piltange	98	88	3	2	3	2	0
25	Dama	29	26	2	1	0	0	0
26	Muglamp	104	75	25	4	0	0	0
27	Nunga	109	80	24	4	1	0	0
28	Golge	64	50	11	1	0	0	0
29	Kindeng	14	13	0	0	0	1	0
30	Kuli	99	95	2	2	0	0	0
31	Kaip	80	63	15	2	0	0	0
33	Arawagai	178	145	4	5	3	1	0
34	Rebiamul	133	118	13	2	0	0	0
35	Kokglamp	122	120	1	1	0	0	0
36	Mt Hagen	64	56	8	0	0	0	0
37	Anga	63	48	8	5	2	0	0
38	Minimp	15	11	3	1	0	0	0
39	Malbuga	101	83	14	3	1	0	0
40	Kelengha	102	80	17	4	0	1	0
41	Bukapena	89	65	24	0	0	0	0
42	Tambul	120	103	13	2	2	0	0
43	Yano	93	66	15	10	2	0	0
44	Tomba	25	17	6	2	0	0	0
45	Alkena	87	66	16	4	1	0	0
46	Kiripia	52	46	4	0	2	0	0
47	Kosap	81	67	12	1	1	0	0
48	Tsingaropa	48	40	6	0	2	0	0
49	Ulga	73	65	8	0	0	0	0
50	Holy Trinity	32	28	3	1	0	0	0

Appendix 41 **FLUOROSIS BY SCHOOL**
% OF PERSONS AFFECTED 11-14 YEARS

School code	School	N	Fluorosis					
			Normal	Quest- ionable	Very Mild	Mild	Moderate	Severe
			N	Q	VM	M	Mo	S
1	Koinambe	95	94	6	0	1	0	0
2	Mt Au	72	65	26	6	1	1	0
3	Tsikisa	43	96	2	0	2	0	0
4	Kwinkya	121	90	5	3	1	0	0
5	Tapiakama	60	83	14	0	2	2	0
6	Kingaringa	69	86	10	3	1	0	0
7	Lumis	108	84	13	3	0	0	0
8	Gobo	76	87	12	1	0	0	0
9	Ambullua	138	93	6	1	0	0	0
10	Tabibuga	110	92	8	1	0	0	0
11	Togban	104	95	4	1	0	0	0
12	Paraka	27	83	17	0	0	0	0
13	Alimp	56	94	5	2	0	0	0
14	Nebilyer	86	84	16	0	0	0	0
15	Kuga	117	76	17	3	2	2	0
16	Fatima	100	96	4	0	0	0	0
17	St Anselm	62	96	4	0	0	0	0
18	Nondugal St Marys	89	72	26	0	2	0	0
19	Ambang	81	73	28	0	0	0	0
20	Millep	85	99	1	0	0	0	0
21	St John Bosco	79	69	25	4	1	1	0
22	Kugark	72	88	6	1	2	4	0
23	Kurumul	97	69	25	4	2	0	0
24	Piltange	98	92	3	2	3	2	0
25	Dama	29	90	8	2	0	0	0
26	Muglamp	104	75	23	3	0	0	0
27	Nunga	109	72	23	3	1	1	0
28	Golge	64	81	18	2	0	0	0
29	Kindeng	14	86	10	0	0	5	0
30	Kuli	99	97	2	1	0	0	0
31	Kaip	80	77	21	2	0	0	0
33	Arawagai	178	82	12	3	2	1	0
34	Rebiamul	133	91	8	1	0	0	0
35	Kokglamp	122	98	1	1	0	0	0
36	Mt Hagen	64	89	11	0	0	0	0
37	Anga	63	78	10	7	5	0	0
38	Minimp	15	73	20	7	0	0	0
39	Malbuga	101	85	12	3	1	0	0
40	Kelengha	102	80	15	4	0	1	0
41	Bukapena	89	72	28	0	0	0	0
42	Tambul	120	84	13	2	1	0	0
43	Yano	93	71	16	10	2	0	0
44	Tomba	25	70	25	5	0	0	0
45	Alkena	87	77	17	5	1	0	0
46	Kiripia	52	89	7	1	3	0	0
47	Kosap	81	86	12	1	1	0	0
48	Tsingaropa	48	85	12	0	3	0	0
49	Ulga	73	91	9	0	0	0	0
50	Holy Trinity	32	90	9	1	0	0	0

Appendix 42 **FLUOROSIS - ACCESS BY ALTITUDE**
NUMBER AND % OF PERSONS AFFECTED

Access code 1 - highway access	Altitude code 1 < 1500 m
2 - mainroad access	2 1501-1900 m
3 - access road access	3 > 1901 m
4 - no road access	
5 - no road and air access	

Age (yrs)	N	Fluorosis					
		Normal N	Questionable Q	Very Mild VM	Mild M	Moderate Mo	Severe S
Code 1-1 - highway access: < 1500 m							
6-7	1	1	0	0	0	0	0
8-10	33	26	7	0	0	0	0
11-14	86	74	12	0	0	0	0
Total	120	101	19	0	0	0	0
%	100	84	16	0	0	0	0
Code 1-2 - highway access: 1501-1900 m							
6-7	21	20	1	0	0	0	0
8-10	299	259	37	2	0	1	0
11-14	437	360	59	11	4	3	0
Total	757	639	97	13	4	4	0
%	100	84	13	2	1	1	0
Code 1-3 - highway access: > 1900 m							
6-7	2	2	0	0	0	0	0
8-10	14	10	4	0	0	0	0
11-14	25	17	6	2	0	0	0
Total	41	29	10	2	0	0	0
%	100	71	24	5	0	0	0
Code 2-1 - main road access: < 1500 m							
8-10	67	63	3	1	0	0	0
11-14	333	294	29	7	3	0	0
Total	400	357	32	8	3	0	0
%	100	89	8	2	1	0	0
Code 2-2 - main road access: 1501- 1900 m							
6-7	5	5	0	0	0	0	0
8-10	296	267	25	0	1	3	0
11-14	829	682	123	15	7	2	0
Total	1130	954	148	15	8	5	0
%	100	85	13	1	1	0	0
Code 2-3 - main road access: > 1900 m							
6-7	4	3	1	0	0	0	0
8-10	87	67	19	1	0	0	0
11-14	209	168	37	2	2	0	0
Total	300	238	57	3	2	0	0
%	100	80	19	1	1	0	0
Code 3-1 - access road access: < 1500 m							
8-10	31	29	1	1	0	0	0
11-14	175	157	15	0	3	0	0
Total	206	186	16	1	3	0	0
%	100	90	8	1	2	0	0

...cont on next page

Appendix 42 continued

Code 3-2 - access road access: 1501-1900 m

6-7	11	10	1	0	0	0	0
8-10	275	245	22	4	4	0	0
11-14	999	835	126	26	8	4	0
Total	1285	1090	149	30	12	4	0
%	100	85	12	2	1	0	0

Code 3-3 - access road access: >1900 m

8-10	74	66	5	2	1	0	0
11-14	302	237	43	16	6	0	0
Total	376	303	48	18	7	0	0
%	100	81	13	5	2	0	0

Code 4-1 - no road access: < 1500m

6-7	1	1	0	0	0	0	0
8-10	21	17	2	1	1	0	0
11-14	167	136	25	4	1	1	0
Total	189	154	27	5	2	1	0
%	100	82	14	3	1	1	0

Code 4-3 - no road access: 1501-1900m

6-7	2	2	0	0	0	0	0
8-10	20	19	1	0	0	0	0
11-14	138	128	9	1	0	0	0
Total	160	149	10	1	0	0	0
%	100	93	6	1	0	0	0

Code 5-1 - no road and air access: < 1500m

6-7	5	5	0	0	0	0	0
8-10	45	43	1	1	0	0	0
11-14	261	231	27	2	1	0	0
Total	311	279	28	3	1	0	0
%	100	90	9	1	0	0	0

Code 5-2 - no road and air access: 1501-1900m

8-10	5	2	2	0	1	0	0
11-14	60	52	7	1	0	0	0
Total	65	54	9	1	1	0	0
%	100	83	14	2	2	0	0

