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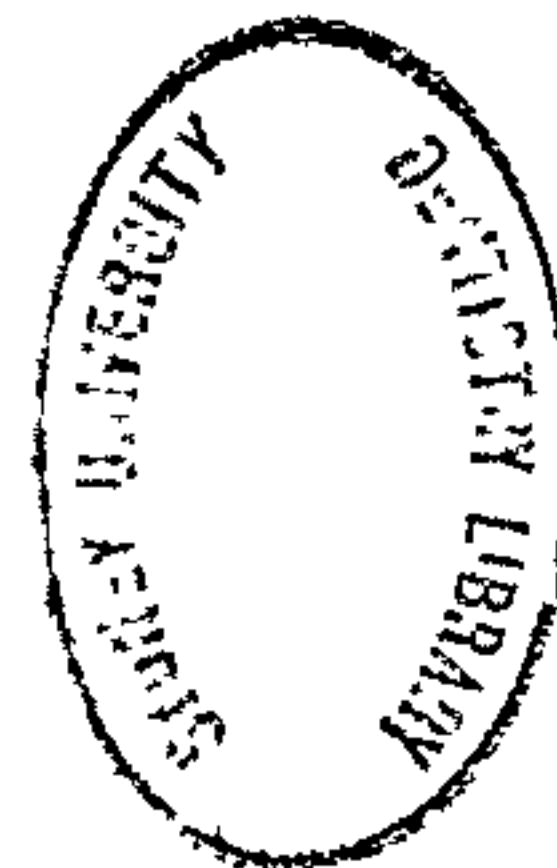
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D. P. H. CONT.

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A SURVEY METHOD
FOR THE ASSESSMENT OF
THE DENTAL HEALTH AND TREATMENT NEEDS
OF A POPULATION.

The examination of a survey method for the collection of data relating to a 16 - 20 year old population group in New South Wales for comparison with data relating to a similar population group in New Zealand.

Submitted as part of the requirements for
the Diploma in Public Health Dentistry
University of Sydney.

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November, 1963

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INTRODUCTION

With the upsurge of interest throughout the world in dental public health, more study is being devoted to dental survey methodology. Experience in the conduct of epidemiological surveys designed for the purpose of finding causes, completing clinical pictures, and assessing the distribution of dental diseases throughout populations, has revealed the need for a standardization of terminology and criteria for reporting dental diseases and conditions. Standards for the definition, and criteria for the assessment of dental caries and periodontal diseases have been proposed and recommended for international adoption by special committees of both the Federation Dentaire Internationale ⁽¹⁾ and the World Health Organisation ⁽²⁾. These standards will facilitate the collection of reliable and reproducible data by dentists of varying educational qualifications and experiences, living in countries with different scientific concepts.

The development of dental public health programmes reflecting different national attitudes and different levels of socio-economic and professional development in many countries, has introduced a need for more comprehensive surveys. Economy in the use of resources now demands further study of survey design to examine methods of collecting quantitative data for the purpose of evaluating existing dental public health programmes, for indicating additional needs, and for comparing the health status of communities with different programmes, while continuing

to provide the information required for extending knowledge of dental diseases.

In both New South Wales and New Zealand one major epidemiological survey has been undertaken during recent years. In 1954 - 55 Barnard (3) examined 6,787 N.S.W. state school children 6 - 15 years of age. During the period 1947 - 52 Hewat⁽⁴⁾ examined 21,622 N.Z. school children 6 - 17 years of age.

In N.S.W. other surveys have been carried out for the purpose of determining dental caries prevalence and incidence rates for limited groups of specific age, sex, race and geographic location.^{(5) (6) (7)} Some of these have included attempts to relate caries to bacterial flora,⁽⁶⁾ diet,^{(5) (6) (8)} and the fluoride content of water. Each of these surveys has been restricted in scope, number of subjects and standardization of methods. In every case the age group 16 - 20 years has been excluded and in most cases dental disease manifestations other than caries have been omitted.

In N.Z. the age group 16 - 20 years has received some investigation as Davies and King⁽⁹⁾ included 12 - 19 year olds in a survey of Secondary School and Teacher Training College Students in 1950. In addition three surveys undertaken by Officers of the Royal New Zealand Dental Corps in 1952, 1954 and 1958, and subsequently reported by Davies (10) (11) included

18 - 21 year old compulsory military training recruits. These surveys were limited in scope to dental treatment histories, caries experience and dental treatment needs resulting from caries.

These few experiences involving the application of reproducible examination techniques to population groups in two neighbouring countries of the British Commonwealth of Nations, have produced a very small collection of data that could be considered comparable. Most of this data relates to caries. Reported surveys have revealed little quantitative data regarding other dental diseases and conditions, that could be used for the purpose of drawing comparisons between the two countries.

This study involves the examination and trial under N.S.W. conditions of a survey method designed by Beck⁽¹²⁾ for use in N.Z. as one phase of a programme for evaluating New Zealand's Dental Public Health Services.

The aims of the survey are:-

1. To investigate the caries prevalence in the 16 - 20 year old population group.
2. To investigate the prevalence of periodontal diseases in this population group.
3. To investigate other facets of the dental condition of this age group, including enamel opacities, enamel hypoplasias, oral calculus, standards of oral hygiene, broken

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incisors, handicapping dento-facial anomalies and impacted teeth.

4. To investigate the amount and nature of dental treatment this population group has received.
5. To investigate the amount and nature of dental treatment required by this age group, in terms of conservative dentistry, periodontics, prosthodontics and oral surgery.

Beck's method for recording and collecting data has been designed to measure in quantitative terms the clinical occurrence of the major dental diseases, defects, and deformities. He has assembled for application in a single comprehensive survey, techniques that have been widely used throughout the world for this purpose, techniques that have proved effective in a limited number of trials, and techniques that have not yet been tested and reported.

For the assessment of clinical caries the Boedecker⁽¹³⁾ the D.M.F. tooth⁽¹⁴⁾ and the D.M.F. tooth surface⁽¹⁴⁾ indices have been reported on many occasions and are acknowledged as reliable and effective.

The Ellis⁽¹⁵⁾ classification of broken incisors has likewise been widely adopted throughout the world.

For the assessment of oral hygiene status and periodontal diseases the systems of classification and scoring of Greene

and Vermillion ⁽¹⁶⁾ and Russell ⁽¹⁷⁾ are of more recent origin but some clinical trials have been reported ⁽¹⁸⁾ ⁽¹⁹⁾.

For the assessment of handicapping dento-facial anomalies Beck has included the classification and index recommended in 1962 by a World Health Organisation Expert Committee on Dental Health ⁽²⁾.

For the assessment of enamel opacities and hypoplasias he has defined a new quantitative index ⁽¹²⁾ for which no clinical trial has yet been reported.

As a preliminary phase of an endeavour to determine the amount and nature of treatment this population group has received, Beck has included a free answer questionnaire which seeks information relating to treatment experiences with dentists in private practice, and the school dental service. The indices selected for the assessment of caries are adapted for recording in quantitative terms treatments received for carious lesions, and he has included a prosthetic code ⁽¹²⁾ which measures in quantitative terms also, treatment received in the field of prosthodontics. Treatment received in respect of other conditions are recorded as comments.

For assessing the treatment needs of the total population group Beck has designed and incorporated in his treatment method a Dental Services Index ⁽¹²⁾ which entails the assignment to each individual member of the group, of a numerical value

weighted arbitrarily for materials, time, and skill required in the dental effort needed to render each subject dentally fit. The scale of values is constant ranging from 0 for the person who is already dentally fit to a large figure for the person requiring considerable treatment. This index applies to the need for conservative dentistry and extractions. The prosthetic code gives absolute figures on the need for prosthodontic treatment and estimates for other treatment needs can be deduced from indices used to record other dental conditions.

It is considered that this study will demonstrate that Beck's method is reproducible and that reliable comparable data can be obtained from surveys conducted simultaneously in N.S.W. and N.Z. without inter-examiner calibration of examination techniques and diagnostic criteria.

REVIEW OF LITERATURE ON SAMPLE SELECTION AND SURVEY METHOD

The purpose of a survey is to identify the real rather than the apparent condition on an accurate factual basis that can be documented and submitted to statistical analysis to test for validity and reliability. Experience has revealed that major dental diseases can affect entire populations but as a matter of expediency and economy, dental surveys usually have to be limited in scope to small samples selected by a process of deliberation. The sampling of human populations is a complex problem more in the fields of competence of the sociologist

and the statistician than the dentist, who requires guidance in sample design. Since the standardised reproducible dental examination has been used on very few occasions in N.S.W. and N.Z., dental literature from these countries contains very few references to sampling technique. In most reports the guidance is acknowledged and the recommended sample design is presented without explanation of the factors influencing sample size and sample selection.

To date most reports have described cross-sectional surveys involving the systematic stratification of populations congregated in selected schools, institutions and units of the armed services. The epidemiological surveys of Barnard (3) and Hewat⁽⁴⁾ were wide enough in scope to give a reliable measure of some aspects of the dental condition of school populations but samples selected for the other limited purpose surveys in both N.S.W. and N.Z. could not be regarded as representing large populations.

The methods of examination used in the two epidemiological surveys included many similar features although there were differences in the criteria and indices used.

Both investigations charted carious lesions and recorded observations on gingival conditions, oral hygiene, occlusion, mottled enamel, and hypoplasias. In addition Hewat recorded superficial stains and pigmentation of enamel.

CARIES

For the examination of carious lesions Barnard used a mouth mirror probe and bitewing radiograph method. For the recognition and assessment of caries he applied the following criteria:

- (a) Occlusal and gingival lesions: if the probe was retained and resisted withdrawal or if softness was palpable.
- (b) Approximal lesions: If roughness capable of holding its point was detected with the probe.
- (c) Hard stained surfaces and enamel imperfections other than those indicated in (a) and (b) were not recorded as carious.

His radiographs were examined on a viewing box with standard illumination using a magnifying glass. Any radiograph apparently showing initial approximal caries was checked against permanently mounted radiographs of lesions selected as standards. Care was taken to ensure that any surface, before being designated carious, showed at least a definite cone-like area of demineralized enamel.

For examining and reporting dental caries he used the D.M.F. surface index. By summarizing this data he was able to deduce for each specific age sex and geographic location group:-

1. The number of decayed (D) missing (M) and filled (F) teeth.

2. The total number of D.M.F. teeth.
3. The number of caries free teeth.
4. The number of teeth designated (X) due for extraction.
5. The number of teeth missing or due for extraction
(M + X).
6. The number of erupted teeth.
7. The number of D.M.F. teeth, caries free teeth,
and teeth erupted, in respect of upper incisors
and 6 year molars.
8. The number of decayed, missing and filled surfaces
in respect of upper incisors, 6 year molars, and
of all permanent teeth erupted.

For his examination of carious lesions Hewat also used a mouth mirror, probe and bitewing radiograph. His criteria for the assessment of caries could be described as similar but not identical.

- (a) A pit or fissure was considered carious if the point of a sharp probe required a definite pull for its removal, after it was inserted.
- (b) Stained pits or fissures, and opacities, or stained areas on smooth surfaces were not regarded as carious unless there was some evidence of enamel dissolution.
- (c) Proximal surfaces were considered carious if the probe caught on a roughened surface.

Bitewing X-rays were examined with a magnifying glass and artificial light, and any opacity of enamel was considered evidence of caries.

For examining and reporting carious lesions, he used the Bodecker⁽¹³⁾ Modified Caries Index identifying three particular types of surfaces, occlusal, proximal, and buccal-lingual, i.e.,

The first and second upper molars: 3 occlusal type surfaces.

Upper and lower incisors and canines, the upper third molars, the lower bicuspid and lower molars: 2 occlusal type surfaces.

Upper bicuspid: 1 occlusal type surface.

All teeth: 2 proximal type surfaces.

Upper and lower incisors and canines: 1 buccal-lingual type surface.

All bicuspid and molars: 2 buccal-lingual type surfaces.

By summarising his collected data he was able to deduce for each specific age, sex, and geographic location group:-

1. Number of D.M.F. tooth surfaces and the rate of D.M.F. tooth surfaces, to tooth surfaces present.
2. Number of tooth surfaces newly affected by caries between successive years, and the annual caries attack rate.
3. Number of teeth erupted.
4. Number of decayed tooth surfaces, as a function of the accumulated post-eruptive tooth age.

Having chosen the Bodecker index Hewat was accounting for 180 tooth surfaces. This large number proved cumbersome and in his report he recommended for future surveys a reduction to 160 tooth surfaces as for the D.M.F. surface index.

Barnard reported that in the age group 6 - 15 years only 1.52% of the children were free of caries in both the deciduous and the permanent dentition. The mean number of D.M.F. permanent teeth per child in this age group varied from 0.99 to 13.91 while the mean number of tooth surfaces varied from 1.6 to 29.1 per child. Of the children included in his survey only 5.77% were free of caries at six years of age, 0.67% at eight years, and 0.00% at fifteen years.

Hewat reported that amongst the European subjects included in his survey the caries index (i.e., the rate of affected D.M.F. tooth surfaces to the total number of tooth surfaces present) was 11.6% at six years of age and 31.4% at 17 years of age. 95% of children aged six years and 98% of children aged 8 years were affected by caries.

This review reveals that although the two methods used were similar, reports of the two surveys, did not contain much data that was directly comparable.

GINGIVAL CONDITIONS

In a recently proposed definition of the periodontium (20) the gingiva has been included with the cementum, the periodontal

membrane and the alveolar bone as constituting all the elements that support the teeth.

Periodontal diseases have thus been defined⁽²⁰⁾ as "those pathological processes of an inflammatory and degenerative type that involve the periodontium. They are generally characterised clinically by gingivitis, pocket formation, loss of alveolar bone, and eventually loss of teeth".

Dental literature from N.S.W. and N.Z. reveals very little information about the prevalence and characteristics of periodontal diseases. Cunningham⁽²¹⁾ has observed that most published work relating to the prevalence of periodontal diseases in Australia and New Zealand is of limited value because it records subjective observations or opinions based solely on visual examination of the gingivae and usually incidental to examinations for caries.

In the two epidemiological surveys study of the periodontium was confined to the gingivae.

Barnard considered the condition of the upper anterior regions of the gingiva could be taken as indicative of the gingival condition of the rest of the mouth, and applied criteria to assess indices as follows:

Normal: Gingiva firm and pink with natural stippled appearance.

H: Gingiva firm with slight loss of pink colour and of stippling.

H.1: Gingiva showing definite hyperaemia.

H.11: Gingiva extremely red and hyperaemic, sometimes with slight oedema of the interdental papilla.

H.1.S: Gingiva showing hyperaemia with oedema of the interdental papilla and margin.

H.11.S: Gingiva extremely red and hyperaemic, with oedema of the interdental papilla and margin and sometimes loss of attached gingivae.

For practical purposes he combined these categories of conditions into three groups.

Normal	:	Normal and H
Hyperaemic	:	H.1 and H.11
Hyperaemic and oedematous:		H.1.S. and H.11.S.

Hewat considered that a difficult and differential diagnosis of diseased gum conditions was inconsistent with the main object of his survey and he adopted the following classification:

Normal gums : Gum tissue uniformly pink and firm.

Inflamed gums: An acute or chronic localised inflammation of the gingival margin, including the interdental papilla, and characterised by a narrow band of bright red tissue surrounding the necks of the teeth.

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Hypertrophic gums: A chronic increase in bulk of the gingivae, primarily manifested in the gum marginal tissue and its attached papillae. Usually observed in the incisor region of the jaws.

Hewat reported that the incisor and molar regions of the jaws were most commonly affected by disease but the assessment was not based on observation of these regions alone.

Once again the use of similar criteria in the two surveys failed to produce comparable information.

ORAL HYGIENE

For estimating the status of oral hygiene in population groups, investigators in N.S.W. and N.Z. have lacked objective tools for quantitative measurement and have relied on fairly subjective criteria.

Barnard assessed the state of hygiene of his subjects as follows:

- Good: The mouth was clean, i.e. there was no debris in the mouth or around the teeth.
- Fair: The mouth was fairly clean, except that there was some debris in small areas.
- Poor: There was a heavy accumulation of debris and no effective effort had apparently been made to remove it.

Hewat assessed his subjects thus:-

Good Hygiene: No discernible debris on the tooth surfaces

Fair Hygiene: Discernible debris on the tooth surfaces.

Bad Hygiene: Pronounced debris on the tooth surfaces.

While these methods of assessment were very similar the boundary lines between classifications were not distinct and and some inter-examiner calibration would have been required for effective comparability of assessments.

OCCCLUSION

The etiological routes for producing efficient and aesthetic occlusion and the factors originating and modifying the development of mal-occlusion are not yet adequately understood. For this reason a satisfactory index for the quantitative description of the type, character, and efficiency of the occlusion of individuals, has eluded definition. Under these circumstances the public health dentist wishing to express in quantitative terms the occlusion status of a population, is seriously handicapped.

Dental literature from N.S.W. and N.Z. can contribute nothing more than the information collected by Barnard and Hewat on the comparative conditions existing in the two countries.

In Barnard's survey occlusion was assessed and recorded as follows:

Normal: Correct approximal contacts and axial position of all teeth, together with normal relationship of the inclined planes of the occlusal surfaces of the teeth when the jaws are closed; normal growth, development, location and correlation of the various associated tissues and parts. Strang (22).

Class I (Not subdivided but including).

(1) Absence of teeth Anodontia.

Exodontia.

Trauma.

(2) Deep overbite

(3) Miscellaneous congenital abnormalities of tooth size.

(4) Malformation of teeth.

Protrusion of upper incisors

Bunched or crowded incisors.

One or more upper incisors locked behind lower.

Drifting molars.

Malposition of one or more teeth buccally or lingually.

Class II (Not subdivided but including).

(1) Distal position of the mandible with protrusion of the upper incisors.

(2) Distal position of the mandible with retrusion of the upper incisors

Class III (Not subdivided but including).

(1) Mandible protruded.

(2) Over-expansion of mandibular arch.

Hewat started his survey by noting gross departures from normal occlusion according to Angle's⁽²³⁾ classification. Later he decided to adopt a broad classification of malocclusion, based on a liberal interpretation of what constituted the "normal", which he considered would be capable of giving some information on the need for orthodontic treatment amongst the population. His later classification recognised the following conditions:

Normal occlusion.

Underdevelopment of the jaws - irregularity of teeth within the jaws.

Malrelation of the jaws Angle Class II.

Malrelation of the jaws Angle Class III.

A combination of underdevelopment and malrelationship of the jaws.

Barnard reported that of the children (6 - 15) years examined, 81.7% male and 80.4% female revealed mal-occlusion

Hewat reported that of the European children (7 - 17) years examined 47% revealed malocclusion.

MOTTILING

Mottling of enamel is a term usually associated with

chronic endemic dental fluorosis and for its diagnosis the classification of Dean⁽²⁴⁾ has been widely accepted for standard use throughout the world.

Neither Barnard nor Hewat used Dean's classification for their surveys.

Barnard explained that for the purpose of his survey mottling meant flecking or idiopathic opacity of the enamel. The teeth affected, and the position of the affected area on each tooth were recorded. These areas showed no change in the contour or surface texture of the enamel but were either opaque white or opaque brown.

Hewat identified and recorded mottling when several teeth had flecks, spots or patches of opaque enamel, usually white but occasionally brownish in colour. At times he noted that several teeth were affected in one mouth but the areas noted had a smooth surface texture. He commented that these areas appeared to correspond roughly to the "questionable" or "very mild mottling" noted by Dean⁽²⁴⁾ in connection with endemic fluorosis.

Barnard reported that in the age group 6 - 15 years, 19.0% of children showed signs of white mottling, and 4.1% showed signs of brown mottling.

Hewat reported that in the age group 12 - 17 years, 16.2% of European subjects showed signs of mottling.

In both surveys the results of the determinations of the fluoride content of water samples were consistently low and for this reason mottling could not be attributable to fluorosis in a single subject.

HYPOPLASIAS

Barnard classified hypoplastic changes in teeth discernible by probe and visual examination as follows:

Mild: A roughening of the enamel surface detected with a probe.

Moderate: Developmental faults such as the presence of small pits, depressions and grooves of the enamel.

Severe: Developmental faults such as the absence of enamel or gross change in tooth morphology involving most of the anatomical crown.

Hewat made no attempt to grade teeth according to the surface character of enamel, nor to distinguish between morphological characteristics of hypoplasia. The surface defects he recorded corresponded to the conditions referred to by Ainsworth⁽²⁵⁾ as infantile, febrile, and local types of hypoplasia.

Barnard reported that in the age group 6 - 15 years 4.5% had mild hypoplasias. 4.5% had moderate hypoplasias and .8% had severe hypoplasias.

Hewat recorded that only .8% of the European and Maori subjects in the 13 - 15 years age group showed signs of hypoplasias.

This review of literature has disclosed that two well planned but unco-ordinated large scale epidemiological surveys failed to produce objective information that could be readily adapted for the establishment of international standards.

At the time these two surveys were designed the concept of the reproducible dental examination for mass surveys had not been well developed and experience in the use of standardized methods had been limited to the reporting of dental caries. In view of these circumstances it has been interesting to observe that the differences that distinguished the terminologies, criteria, and methods chosen by the two epidemiologists for the examination of subjects and for recording and reporting data, were of small dimensions.

The advantages of achieving international uniformity are now acknowledged and some standards have already been defined and recommended for use in future surveys. These standards can be incorporated into the design of comprehensive surveys that will simultaneously provide information for the purpose of epidemiological research, while determining treatment needs for the planning and evaluation of public health programmes, and testing methods for the individual and mass prevention of dental diseases.

MATERIALS AND METHOD

A. Sample Design

The population group investigated included males and females 16-20 years of age (inclusive), and resident in New South Wales.

The Commonwealth Bureau of Census and Statistics made available an analysis of the 16-20 year old N.S.W. population classified according to industrial occupation. This analysis had been extracted from the record of the Census of 30th June 1954.

TABLE I.

NEW SOUTH WALES POPULATION 16-20 YEARS INCLUSIVE.

CLASSIFIED ACCORDING TO INDUSTRIAL OCCUPATION.

CENSUS 30TH JUNE 1954.*

Industry	Male	Female	Total	Percentage of 16-20 year Population
Primary	17,925	1,456	19,381	9
Manufacturing) Servicing) Industries and Utilities	53,049	23,868	76,917	35
Finance Property Business Commerce	18,930	26,767	45,697	20
Public Authorities	8,236	16,280	24,516	11
Personal Services Students and others not in work force	16,685	38,905	55,590	25

* Exclusive of full blooded aboriginals

The Commonwealth Bureau of Census and Statistics also made available an analysis, extracted from the Census of 30th June 1954, of the total N.S.W. population classified according to residential state. The Bureau advised that for the purpose of this survey it could be assumed that the distribution of the 16-20 year old population group according to residential state was similar to that of the total population.

TABLE II.

NEW SOUTH WALES TOTAL POPULATION CLASSIFIED
ACCORDING TO RESIDENTIAL STATE.

CENSUS 30th JUNE 1954. *

Division of State	Male	Female	Total	Percentage of Total Population
Metropolitan Urban	909,978	953,183	1,863,161	54.4
Other Urban	485,128	480,259	965,387	28.2
Rural	319,562	268,549	588,111	17.2
Migratory	6,192	678	6,870	0.2
TOTAL N.S.W.	1,720,860	1,702,669	3,423,529	100.0

* Exclusive of full blooded aboriginals

In planning this survey the limitations imposed by the lack of resources of time and finance at the disposal of the investigator and the paucity of available information about the characteristics of this age group were major factors for consideration. In these circumstances it was necessary to

sub-divide the total population group into strata of acknowledged uniformity in respect of one attribute and to estimate from the limited information available regarding oral conditions and treatment needs, the minimum sample size required to allow a valid interpretation of observations.

The total population group was subdivided into strata conforming with the industrial occupation classification listed in Table I, and some account was taken of the residential state classification listed in Table II.

The plan provided for sample proportions in each of the five industrial occupation strata equal to the proportions of the population group that occurred in the corresponding classes in the census analysis Table I. In addition provision was made for the metropolitan urban, the other urban, and the rural categories of the population group to be represented in the sample in approximately the same proportions as for the total N.S.W. population in the census analysis Table II.

For determining the required sample size Barnard's Report⁽³⁾, which included information regarding the age specific caries prevalence in permanent teeth of 12, 13, 14 and 15 year old school children in N.S.W., was used as a guide. The sample size required to ensure a valid interpretation of observations relating to age specific differences in this particular variable was estimated and in the absence of information regarding other conditions, it was necessary to assume that the number of subjects determined by this estimation would be adequate for the consideration of other variables.

TABLE III.

PREVALENCE OF DENTAL CARIES IN PERMANENT TEETH.

CHILDREN 12 - 15 YEARS OF AGE.

NEW SOUTH WALES *

	AGE GROUP			
	12 YEARS	13 YEARS	14 YEARS	15 YEARS
NUMBER OF CHILDREN	667	696	660	428
MEAN NUMBER D.M.F. TEETH/child	9.32	10.70	12.78	13.91
STANDARD DEVIATION	5.33	5.15	5.59	5.45
STANDARD ERROR	± 0.207	± 0.195	± 0.217	± 0.263

* DATA EXTRACTED FROM BARNARD P.D. - DENTAL SURVEY OF
STATE SCHOOL CHILDREN IN NEW SOUTH WALES. TABLE XI.
PAGE 39.

After study of Barnard's data presumptions were made that the age specific mean number of D.M.F. teeth in the age group 16 - 20 years would increase each year by a figure not less than one and not greater than two, and that the standard deviation for each age specific D.M.F. mean would be not less than five and not greater than six.

The sample size required for the measurement of differences in the age specific mean D.M.F. scores, to achieve an accuracy at the 95 per cent confidence level, was then estimated.

Basis for Preliminary Estimation

Standard Error of Mean (S.E.) for each age specific group = $\frac{\text{Std. Deviation}}{\sqrt{\text{Number in group}}}$

$$\therefore \text{Required Number in each Age Specific Group (N)} = \left(\frac{\text{Std. Deviation}}{\text{S.E.}} \right)^2$$

$$\text{Presumed Difference in Age Specific Mean D.M.F. Scores} = 1.5$$

$$\text{Presumed Standard Deviation (S.Dev) for each Age Specific Mean D.M.F. Score} = 5.5$$

$$\begin{aligned} \text{Standard Error of Difference (S.E. of Diff)} &= \sqrt{\text{S.E.}^2 + \text{S.E.}^2} \\ &= \sqrt{2 \times \text{S.E.}^2} \\ &= \sqrt{2} \times \text{S.E.} \end{aligned}$$

$$\begin{aligned} \text{Significance Ratio Required i.e.} \\ \frac{(\text{Difference})}{(\text{S.E. of Diff})} &= 2 \text{ or more than } 2 \end{aligned}$$

Preliminary Estimation

$$\begin{aligned} \text{S.E. of Difference} &= \frac{\text{Difference}}{2 \text{ (or more)}} \\ &= \frac{1.5}{2 \text{ (or more)}} = 0.75 \text{ (or less)} \end{aligned}$$

$$\text{S.E. of Difference} = \sqrt{2} \times \text{S.E.}$$

$$\begin{aligned} \therefore \text{S.E. of Mean} &= \frac{\text{S.E. of Diff}}{\sqrt{2}} = \frac{0.75}{\sqrt{2}} \text{ (or less)} \\ &= \frac{0.75 \text{ (or less)}}{1.41} = 0.53 \text{ (or less)} \end{aligned}$$

$$\begin{aligned} \text{Minimum Number required for each age Specific Group} &= \left(\frac{\text{S. Dev}}{\text{S.E. of Mean}} \right)^2 = \left(\frac{5.5}{0.53} \right)^2 \\ &= 106 \end{aligned}$$

Subsequent estimations using alternative values, chosen from within the presumed ranges, for differences in age specific mean D.M.F. scores and standard deviations, revealed that 105 was an approximate median estimate of the number required for each age specific group. From these estimations an inference

was drawn that for the purposes of this study, and in view of the circumstances under which it was being conducted, the minimum number required for a sample of the 16 - 20 year population group was 530.

Categories of subjects for inclusion in the sample were then selected on the basis of knowledge and experience in the possession of three public health agencies:- the Anti-Tuberculosis Association, the N.S.W. Department of Public Health and the Department of Preventive Dentistry, Faculty of Dentistry, University of Sydney. These categories were drawn from Institutions and Businesses engaging 16 - 20 year old males and females in metropolitan urban, other urban, and rural locations, and identified for their interest in public health, and considered to be accessible to the investigator within the limits of the resources available to him.

In each case the co-operation of the administration and management was sought by personal interview. When this co-operation was offered, the aims of the survey were explained to the selected category. Subjects examined were all volunteers and to reduce the bias likely to arise from self selection an attempt was made to ensure that every available person in each selected category was included in the sample.

TABLE IV.

SAMPLE OF NEW SOUTH WALES POPULATION
16 - 20 YEARS INCLUSIVE.

CLASSIFIED ACCORDING TO INDUSTRIAL OCCUPATION.

APRIL - OCTOBER 1963.

Industry	Code	Male	Female	Total	Percentage of 16 - 20 year sample
Primary	1	21	0	21	4
Manufacturing) Industries	2	142	63	205	35
Servicing and Utilities					
Finance Property Business Commerce	3	36	72	108	19
Public Authorities	4	22	43	65	11
Personal Services Students and others not in Work Force	5	68	108	176	31
Total Sample		289	286	575	100

TABLE V.

SAMPLE OF NEW SOUTH WALES POPULATION
16 - 20 YEARS INCLUSIVE.

CLASSIFIED ACCORDING TO RESIDENTIAL STATE.

APRIL - OCTOBER, 1963.

Division of State	Code	Male	Female	Total	Percentage of 16 - 20 year sample
Metropolitan Urban	A	174	173	347	60
Other Urban	B	44	113	157	27
Rural	C	71	0	71	13
Total Sample		289	286	575	100

TABLE VI.

SAMPLE OF NEW SOUTH WALES POPULATION
16 - 20 YEARS INCLUSIVE.

CLASSIFIED ACCORDING TO AGE AND SEX.

APRIL - OCTOBER 1963.

Age in Years	Male	Female	Total	Percentage of 16 - 20 year sample
16	79	46	125	22
17	62	77	139	24
18	58	57	115	20
19	56	63	119	21
20	34	43	77	13
TOTAL SAMPLE	289	286	575	100

B. CLINICAL EXAMINATION OF SUBJECTS
AND RECORDING OF ORAL CONDITIONS AND
TREATMENT NEEDS.

For this investigation the method designed by Beck⁽¹²⁾ for the New Zealand survey was modified in the interest of economy in use of time and resources, and in respect of some treatment service factors that did not apply in N.S.W. Although there was no opportunity for calibrating criteria with Beck, the planning of this survey coincided with the preparation for another survey in N.S.W. and the writer undertook a period of training with the other survey team. The two plans included differences in criteria but the period of training and calibration provided a valuable exercise in standardising clinical examination techniques. For the survey, all examinations were carried out by one examiner.

Prior to examination each subject was asked to complete a questionnaire to include the following information:

NAME

ADDRESS

AGE (in years) DATE OF BIRTH

COUNTRY OF BIRTH

OCCUPATION EMPLOYER

HOW OFTEN DO YOU BRUSH YOUR TEETH?

SELDOM

☐

DAILY

☐

TWICE DAILY

☐

THREE TIMES DAILY ☐

HOW MANY MONTHS SINCE YOU LAST WENT TO A DENTIST?

DID YOU ATTEND A DENTIST REGULARLY THROUGHOUT

CHILDHOOD AND UP TO THE PRESENT TIME?

This questionnaire was recovered at the time of examination when an exclusive case number was assigned to each subject and location and occupation codes were deduced from the above information, and recorded.

The subjects were seated in a dental chair in good natural light which was supplemented by artificial light from a standard type adjustable lamp.

Examinations were carried out with a sterilized No.5 plane mirror and an Ash No.49 explorer.

The survey design provided for the use of a portable X-ray to take two posterior bitewing films, two upper anterior periapical films and two lower anterior periapical films, for each subject who was not totally edentulous in any of these regions. This plan was modified during the course of the survey because of the technical difficulties encountered in using the X-ray equipment mounted in a mobile dental inspection unit, and the time required to overcome the difficulties.

These problems were related to the height of the young adult patient, the vertical dimension of the dental examination unit and the design of the X-ray equipment.

For many tall subjects the roof of the examination unit obstructed the elevation of the head of the X-ray, before adequate angulation could be attained for the upper anterior teeth.

For lower anterior and posterior teeth an adequate vertical and horizontal extension could be attained but the head of the X-ray tended to move out of focus as the operator stepped across the floor of the unit to seek the protection of the lead screen. After considerable time had been spent in a trial and error method of selecting a parking site with the optimum gradient that allowed adjustment of the two rear levelling jacks of the vehicle, to take the weight of the examination unit off the springs while setting on a level floor, it was considered expedient to modify the method.

Thereafter two posterior bitewing radiographs were taken whenever two or more posterior teeth were in approximation in any one quadrant of the mouth. Periapical radiographs were exposed whenever visual examination revealed a clinical condition that warranted the additional exposure to X-Radiation.

For one group of subjects, X-ray facilities were not available at the time of examination. For this group provision was made for an adjustment of the number of affected proximal surfaces recognised clinically, according to an estimate made for age and sex, of the additional proximal surfaces disclosed by X-ray in the other subjects.

Information obtained by each examination was noted by a recorder on a specially prepared Xeroxed Chart. (Appendix I).

Each tooth was examined in order from the upper left to the upper right third permanent molar and then from the lower left to the lower right third permanent molar.

Tooth surfaces were examined in accordance with the following procedure.

- (a) Occlusal, buccal, lingual surfaces of the last permanent molar in the upper left quadrant.
- (b) Distal surface of the same tooth.
- (c) Mesial surface of that tooth.

This procedure was repeated for each tooth in the order stated above.

The examiner dictated the condition of each permanent tooth space and tooth surface and the following symbols and colours were used to record the condition of each tooth surface:

- (i) Red shading - caries diagnosed clinically, including secondary caries on an already filled surface.
- (ii) Blue shading - filled, non-carious.
- (iii) C - Crowned tooth.
- (iv) Dot - Tooth sound.
- (v) X - Tooth extracted for caries.
- (vi) XO - Tooth extracted for orthodontic reasons.
- (vii) Dash - Tooth unerupted, congenitally absent or fractured.

A permanent tooth was regarded as in eruption if any portion projected through the oral mucosa. In examining for caries a deep fissure was not recorded as carious unless there was more evidence than a catch of an explorer. Other evidence included the detection of a softened cavity floor on light explorer pressure, visual evidence of backward decay of enamel, and visual evidence of deterioration of the pit or fissure wall. Catches were tested by rocking the explorer after it entered the pit or fissure.

While undertaking this examination and diagnosis of the clinical condition of each tooth, the examiner simultaneously assessed and nominated the treatment needs for each tooth.

Each filling or other operation required was called by a code which the recorder entered in appropriate boxes provided on the chart for treatment requirements assessed by clinical examination.

The code was composed of one, two, or three symbols, the major, the minor and the qualifying for each tooth. The symbols used for recording the code of treatment needs are listed as follows.

<u>MAJOR SYMBOL</u>	<u>MINOR SYMBOL</u>
(Treatment required)	(Treatment required)
None 0	Buccal and/or lingual
Class I Filling .. 1	extension to Class I
MO. Filling 2	or Class II Filling .. A

D.O. Filling ...	3	Cusp Restoration ...	B
M.O.D. Filling ..	4	Endodontia ...	C
Class III Filling	5	<u>QUALIFYING SYMBOL</u>	
Class IV Filling ..	6	(Treatment required)	
Class V Filling ..	7	New filling (or crown,	
Crown ...	8	or bridge) X	
Bridge ...	9	Replacement filling	
Extraction ...	10	(or crown, or bridge) .. Y	
		Extension to existing	
		filling Z	

This procedure of assessing and calling treatment requirements for each tooth, while the subject was in the chair, was followed during the early stages of the survey. As the survey progressed it was observed that treatment needs in respect of many teeth could be adequately assessed from the record of condition, at the time of analysis of data. In view of this observation it was considered expedient to reduce the examination time required for each subject, except where clinical conditions indicated a definite need for immediate clinical assessment.

In the later stages of the survey the treatment needs were nominated while the subject was in the chair, whenever the lesion presented an abnormal feature, and whenever multiple operations on the one tooth were considered necessary. In other cases the assessment of treatment needs was deferred until after each day's examination had been completed. These treatment

needs were subsequently confirmed on examination of radio-graphs.

After recording the extracted teeth, the decayed and filled tooth surfaces and the treatment needs, the examiner scored the mouth for oral debris and oral calculus in accordance with the Greene & Vermillion (16) method.

Oral debris scores were assigned as follows:

Two scores (one buccal and one lingual) to each of the six segments of the mouth: lower left, lower anterior, lower right, upper left, upper anterior, upper right.

0 - No debris or stain present.

1 - Soft debris covering not more than one third of the tooth surface, or the presence of extrinsic stains without other debris, regardless of surface area covered.

2 - Soft debris covering more than one third, but not more than two thirds.

3 - Soft debris covering more than two thirds of the exposed tooth surface.

Oral calculus scores were assigned as follows:

Two scores (one buccal and one lingual) to each of the six segments of the mouth: lower left, lower anterior, lower right, upper left, upper anterior, upper right.

0 - No calculus present

1 - Supragingival calculus covering not more than one third of the exposed tooth surface.

- 2 - Supragingival calculus covering more than one third but not more than two thirds of the exposed tooth surface, or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth, or both.
- 3 - Supragingival calculus covering more than two thirds of the exposed tooth surface, or a continuous heavy band of subgingival calculus around the cervical portion of the tooth, or both.

The condition of the periodontal structures was then examined and scores were assigned according to a modification of the Russell Method (17). No radiographic examination was undertaken.

Scores were assigned as follows:

- 0 - Negative. There was neither overt inflammation in the investing tissues nor loss of function due to destruction of supporting tissues.
- 1 - Mild gingivitis. There was an overt area of inflammation in the free gingiva, but this area did not circumscribe the tooth.
- 2 - Gingivitis. Inflammation completely circumscribed the tooth, but there was no apparent break in the epithelial attachment.
- 6 - Gingivitis with pocket formation. The epithelial attachment had been broken and there was a pocket (not merely a deepened gingival crevice due to swelling in the free

gingivae). There was no interference with normal masticatory function, and the tooth was firm in its socket, and had not drifted.

8 - Advanced Destruction with loss of Masticatory Function.

The tooth had become loose, had drifted, sounded dull on percussion with a metallic instrument or was depressible in its socket.

Opacities and Hypoplasias of enamel were then noted.

The degree to which the dentition was affected was recorded on a 1 to 6 scale. The term opacity was applied to include any abnormality in translucency and intrinsic pigmentation. In all cases the enamel was smooth.

The six degrees of opacity were scored as follows:

- 1 - White opaque flecks, spots, or patches, involving less than 25 per cent of the surface area, and involving six teeth or less.
- 2 - Same as 1, but involving more than six teeth.
- 3 - White opaque flecks, spots or patches involving 25 to 50 per cent of the surface area, and involving six teeth or less.
- 4 - Same as 3, but involving more than six teeth.
- 5 - White opaque flecks, spots or patches involving more than 50 per cent of the surface area, and involving six teeth or less.
- 6 - Same as 5, but involving more than six teeth.

The six degrees of Hypoplasia were scored as follows:

- 1 - Part or whole of the enamel surface rough but there was no evidence of pitting, and six or less teeth involved.
- 2 - Same as 1, but with more than six teeth involved.
- 3 - The enamel surface was rough and there was pitting which involved less than 50 per cent of the surface area, and six teeth or less were involved.
- 4 - Same as 3, but with more than six teeth involved.
- 5 - The enamel surface was rough and there was pitting which involved more than 50 per cent of the surface area, and six teeth or less were involved.
- 6 - Same as 5, but with more than six teeth involved.

Subjects wearing dentures or requiring denture services were assigned scores according to a prosthetic code as follows:

Upper Lower

0	0	Edentulous - new full denture required.
1	1	Full clearance required - new full denture required.
2	2	Wearing full denture - satisfactory.
3	3	Wearing full denture - replacement required.
4	4	Wearing full denture - repair or remake required.
5	5	Partially edentulous - new partial denture required.
6	6	Extractions required - new partial denture required.
7	7	Wearing partial denture - satisfactory.
8	8	Wearing partial denture - replacement required.
9	9	Wearing partial denture - repair or remake required.

Subjects presenting fractured anteriors were then noted.

Any teeth that had been fractured were recorded according to Palmer's Notation and The Ellis⁽¹⁵⁾ Classification of fractures as follows:

- Class 1 Simple fracture of the crown - involving little or no dentine.
- Class 2 Extensive fracture of the crown - involving considerable dentine, but not the dental pulp.
- Class 3 Extensive fracture of the crown - involving considerable dentine and exposing the dental pulp.
- Class 4 The traumatised tooth which had become nonvital - with or without loss of crown structure.
- Class 5 Teeth lost as a result of trauma.
- Class 6 Fracture of the root - with or without loss of crown structure.
- Class 7 Displacement of a tooth - without fracture of crown or root.
- Class 8 Fracture of the crown en masse and its replacement.
- Class 9 Traumatic injuries to deciduous teeth.

The fact that the fractured tooth had, or had not, received treatment was also recorded.

Oral Surgery Treatment Requirements were assessed. The presence of impacted third molars found on clinical examination was recorded. Where the clinical picture suggested possible impaction radiographs were taken.

Other minor conditions requiring oral surgery were noted. The condition was specified and the examiner's decision as to whether or not treatment was required was recorded.

The presence of Handicapping Dento-Facial Anomalies⁽²⁾ and the decision as to whether or not treatment was required, were recorded. The anomaly was regarded as requiring treatment if it was considered likely to be an obstacle to the patient's physical or emotional well-being.

If treatment were considered necessary, the nature of the anomaly was indicated in the following list:

Cleft lip

Cleft palate

Prognathism

Retrognathism

Crowding

Spacing

Deep overbite

Open bite

Other - Specify.

Other conditions and comments were noted on the examination chart.

On completion of this clinical examination posterior bite-wing radiographs were exposed. The number of films varied with the length of the alveolar process and the arrangement of the teeth but where teeth were isolated or spaced to allow adequate visual examination of mesial and distal surfaces, radiographs were not taken. These exposed bitewing radiographs were placed with other radiographs exposed for diagnostic purposes in an envelope which was inscribed with the exclusive case

number for the subject and the number of exposed radiographs. .

C. POST-CLINICAL EXAMINATION COMPLETION
OF RECORD OF ORAL CONDITIONS AND TREATMENT
NEEDS.

After examining each group of patients and before an analysis of data could be started it was necessary to complete the records of examinations and treatment needs. This procedure was undertaken for each group as soon as possible after each group examination. The steps were as follows:

1. Each completed questionnaire was checked and the information was transferred to the corresponding record chart.
2. The treatment needs that had not been completely assessed at the time of clinical examination, were assessed and recorded.
3. Exposed radiograph films were developed in batches by standardised techniques and returned to the numbered envelopes.
4. The developed radiographs were examined on a viewing box using standard illumination and magnifying glass. The surfaces not recognised as carious by clinical examination, but diagnosed as carious by radiographic examination, were recorded on the charts by green shading.
5. Treatment needs recorded in code on clinical or subsequent assessment, but requiring reconsideration following radiographic diagnosis, were amended and re-entered on the chart

according to the same code and using the same symbols, but in the boxes provided for treatment requirements assessed by X-ray examination.

ANALYSIS OF COLLECTED DATA BY ORGAN- ISATION AND SUMMARIZATION

The collected data relating to dental conditions and treatment needs was organised and summarised into numerical expressions and indices as follows:

A. Dental Caries Experience and Treatment Needs Resulting From Caries.

From the conventional Bodecker charting scores were computed for the following:

1. Bodecker Modified Caries index.
2. D.M.F. Surfaces index.
3. D.M.F. Tooth index.
1. Bodecker Caries index.

The number of affected surfaces, i.e., carious or filled, of each type (occlusal, proximal, buccal-lingual) were recorded for each tooth in the spaces provided. Teeth that had been extracted for caries or crowned were scored as 1 occlusal, 1 proximal and 1 buccal-lingual affected surface. Teeth recorded as X0 or dash were disregarded both for scoring affected surfaces and for computing total surfaces.

The total number of affected surfaces of each type was then entered under the heading "Affected" and the total of the three types was computed.

The total number of surfaces normally present was deduced for each subject and recorded under "Total". Teeth extracted for caries were included in the total surfaces. Teeth recorded XO or dash were not included in the total surfaces. For subjects with no XO or dash teeth and possessing all teeth including third molars erupted, the total numbers of surfaces present amounted to:

Occlusal	-	64
Proximal	-	64
Buccal-Lingual	-	52
Total	-	180

The Caries Index was then deduced for individual subjects for each surface type, and for all surfaces, from the following formula -

$$\text{Caries Index} = \frac{\text{Affected Surfaces}}{\text{Total Surfaces}} \times 100$$

2. D.M.F. Surface Index

This was based on the U.S.P.H.S. convention of five surfaces for all teeth. From the Bodecker record, using the work sheets shown in (Appendix II) each tooth was scored for the number of decayed (D), filled (F), missing (M) and extraction indicated (designated 10 in treatment requirement box and recorded as X on work sheet) surfaces. Those teeth with 6 or

7 surfaces on the Bodecker diagram were condensed to a five surface diagram for scoring. Thus, two occlusals were counted as one surface; buccal fissure and buccal cervical were counted as one surface; palatal fissure and palatal cervical were counted as one surface. If either or both surfaces were affected, the one condensed surface was considered affected. If one of the condensed surfaces was filled and one carious, the condensed surface was considered carious.

Teeth missing for caries or requiring extraction were scored as 5 surfaces M, or 5 surfaces X, respectively.

Unerupted teeth and teeth extracted for orthodontic reasons were not included.

3. D.M.F. Tooth Index

The total number of teeth normally present was deduced from the dental chart. This figure included teeth extracted for caries and third molars when present, but did not include teeth recorded as XO or dash.

The number of teeth (D) included teeth decayed and teeth filled but decayed.

The number of teeth (M) included those recorded as X, i.e. extracted for caries. It did not include teeth recorded as XO or dash.

The number of teeth (F) included teeth that were filled and were not otherwise carious.

The number of teeth (DMF) represented the accumulated teeth (D), (M) and (F) for the individual.

The accuracy of this last figure was checked and confirmed by applying the equation

$$\text{DMF teeth} + \text{Sound teeth (marked with a dot)} = \text{total teeth.}$$

DENTAL SERVICES INDEX FOR TREATMENT NEEDS RESULTING FROM CARIES

From the code of dental treatment requirements entered on the chart for each subject in the form of precise dental operations required for each tooth, as assessed on clinical examination and re-assessed on examination of radiographs, a Dental Services Index was computed for each subject by accumulating the Dental Services Values assigned for each particular type of treatment need recorded.

The summary of the Code of Dental Treatment needs is repeated below and is followed by the list of Dental Service Values corresponding with this code.

CODE OF DENTAL TREATMENT NEEDS

<u>MAJOR SYMBOL</u>				<u>MINOR SYMBOL</u>			
(Treatment Required)				(Treatment Required)			
None	..	..	0	Buccal and/or lingual extension			
Class I Filling	..	1		to Class I or Class II Filling	..	A	
M.O. Filling	..	2		Cusp Restoration	..	..	B
D.O. Filling	..	3		ENDodontia	..	..	C
MO.D Filling	..	4					
Class III Filling	..	5					
Class IV Filling	..	6					

QUALIFYING SYMBOL

(Treatment Required)

Class V Filling ..	7	<u>QUALIFYING SYMBOL</u>	
Crown	8	(Treatment Required)	
Bridge	9	New filling (or crown, or bridge) ..	X
Extraction	10	Replacement filling (or crown, or bridge)	Y
		Extension to existing filling ..	Z

DENTAL SERVICES VALUES CORRESPONDING
WITH CODE OF TREATMENT NEEDS

CODE	DENTAL SERVICES VALUE		CODE	DENTAL SERVICES VALUE		CODE	DENTAL SERVICES VALUE	
	Premolar	Molar		Premolar	Molar		Premolar	Molar
1X	100	125	2CX	555	595	4Z	100	125
1Y	100	125	2CY	555	595	4AX	230	290
1Z	100	125				4AY	230	290
1AX	100	125	3X	150	190	4AZ	100	125
1AY	100	125	3Y	150	190	4BX	275	345
1AZ	100	125	3Z	100	125	4BY	275	345
1CX	505	525	3AX	150	190	4BZ	100	125
1CY	505	525	3AY	150	190	4CX	635	696
			3AZ	100	125	4CY	635	695
2X	150	190	3BX	275	345			
2Y	150	190	3BY	275	345	7X	100	125
2Z	100	125	3BZ	100	125	7Y	100	125
2AX	150	190	3CX	555	595	7Z	100	125
2AY	150	190	3CY	555	595	7CX	505	525
2AZ	100	125				7CY	505	525

2BX	275	345	4X	230	290		
2BY	275	345	4Y	230	290	10	150 175
2BZ	100	125					

CODE	DENTAL SERVICES	VALUE
------	--------------------	-------

5X	175
5Y	175
5CX	580
5CY	580
6X	630
6Y	630
6CX	1035
6CY	1035
8X	800
8Y	800
8CX	1205
8CY	1205
9X	1200
9Y	1200
9CX	1605

Partial denture 840

Full denture 1680

Exam., Propy.,
& X-Rays 210

B. Oral Debris, Oral Calculus, Oral Hygiene.

In accordance with the Greene and Vermillion method an index for oral debris and an index for oral calculus was calculated for each subject and these two indices became the components for the oral hygiene index which was then computed by addition of the two numerical expressions.

The oral debris and oral calculus indices were calculated separately but in the same manner. The 12 scores recorded for the buccal and lingual aspects of the 3 upper and the 3 lower segments of the mouth were added together and divided by the total number of segments containing permanent teeth. The range of scores for both debris and calculus was 0 - 36 and the range for each index was 0 - 6.

When these two indices were combined the range for the oral hygiene index was 0 - 12.

An additional index, nominated the Descriptive Calculus Code and designed to record the prevalence of deposits of calculus by clinical types, and locations in the mouth, was then computed as follows.

- | | |
|--------------------|--------------------|
| 1. Light deposits | A. Lower anteriors |
| 2. Medium deposits | B. Upper molars |
| 3. Heavy deposits | C. Other teeth. |

This index was computed directly from the assessment of scores on clinical examination for the Greene and Vermillion calculus index. The ratings light, medium and heavy corresponded with the scores 1, 2 & 3 respectively in the Greene

and Vermillion calculus index.

C. Periodontal Conditions.

The Russell Periodontal Index was then determined by computation from the individual tooth scores assessed on clinical examination. The tooth scores for each subject were accumulated and divided by the number of teeth in the mouth to give an index ranging from 0 - 8.

Having completed the organisation of this information relating to caries, oral debris, oral calculus, oral hygiene and periodontal disease, a summary was prepared for each subject in the form of a series of numerical expressions for the following:

- Case Number
- Age
- Sex
- Race
- Location
- Occupation
- Occ. Caries Index
- Prox. Caries Index
- B.-L. Caries Index
- Gen. Caries Index
- Total Teeth
- D Teeth
- F but D Teeth
- M Teeth
- X Teeth
- F Teeth
- DMF Teeth
- D Surfaces
- F Surfaces
- M Surfaces
- X Surfaces
- DMXF Surfaces
- Services Index
- G. & V. - Debris
- G. & V. - Calculus
- G. & V. - O.H.
- Brushing
- Russell Perio.

Prosthetic
Calculus
Opacity
Hypoplasia
Last Appt.
Treatment History.

DISCUSSION

The solution of many of the problems of public health research planning is dependent upon resources of existing knowledge, time, finance and co-operation.

In the investigation under discussion the immediate objective of the survey was to collect data relating to a sample of the 16-20 year old population group in New South Wales for the purpose of assessing the dental health status and treatment needs of that population group. A more detached objective was to use that data for the purpose of drawing comparisons with data collected by a similar method and relating to a similar population group in New Zealand. Having regard for both the immediate and the long term objectives, the important phase in the planning of the investigation was the design of the sample.

For sample design the basic principle is well established that the only statistical means of avoiding the bias originating from uncontrolled variations inherent in biological material is randomization.⁽²⁶⁾ However the application of a random sampling procedure requires a large measure of each of the above mentioned resources of knowledge, time, finance and

co-operation and random sampling can seldom be achieved for epidemiological surveys in modern complex societies unless the population group is restricted to subjects congregated in the disciplined environment of educational institutions or the armed forces.

For this study the available resources were inadequate for the application of a random sampling technique. At the same time knowledge of the oral conditions and treatment needs of the 16-20 year old population group in N.S.W. was inadequate to allow a rational subdivision of the group into strata of assumed homogeneity of dental attributes.

Under these circumstances the population group was divided into strata of known occupational qualifications. From each strata categories, known to be accessible and willing to co-operate, were selected and an attempt was made to ensure that every available person in each selected category was included in the sample. This method of deliberate selection produced a limited sample that could not be considered representative of the population group.

The circumstances that imposed the necessity for sample selections also imposed a necessity for restricting sample size. The sample was limited to an approximate minimum as determined by estimation based on existing knowledge of the distribution of caries assessed at the clinical stage of cavitation, or as past caries in the form of teeth restored or teeth extracted, in a younger population group than the population group under investigation.

This procedure produced a sample of critical size for the consideration of the high prevalence condition caries, and likely to prove too small for the consideration of other attributes expected to occur at a lower frequency rate in this age group.

In estimating the required minimum sample size also, lack of factual knowledge of the dental attributes of the 16-20 year age group made it necessary for the investigator to assume that the age specific caries incidence rate for young adults engaged mainly in the work force would be approximately the same as for school children. This assumption made no allowance for the obvious fact that the transition from the one period of life to the other is attended by many changes that could modify radically the complex of etiological factors leading to caries and other dental conditions.

For these reasons the data that has been assembled can not be subjected to complete statistical evaluation based on the laws of probability and might not be adequate for the determination of the statistical significance of differences that may be observed between the N.S.W. and N.Z. samples.

The method used in this investigation was comprehensive as it made provision for relating an extensive range of dental conditions to a wide range of group characteristics including age, sex, industrial occupation, residential location, tooth brushing habit, and dental treatment history. The detailed report of the method has included descriptions of examination techniques used, definitions of diagnostic criteria applied and

explanations of indices assessed for measuring in quantitative terms observed caries, oral debris, oral calculus, oral hygiene, periodontal disease, enamel opacities, enamel hypoplasias and broken incisor teeth.

In regard to survey method certain principles have been studied and are now widely accepted. Examination techniques must be specifically adapted to accommodate the maximum number of subjects in the shortest space of time. The essential features of a practical technique are speed and facility of application by examiners of standard background training and experience using the minimum of simple and inexpensive equipment. The technique is required to give reasonably accurate results that are consistently reproducible by the same or several examiners.

Criteria for the diagnosis of populations should not depend on examiner judgement but should be based on clearly defined objective signs. For conditions of high prevalence such as caries in N.S.W. and N.Z., refinement of examination technique and diagnostic criteria is unnecessary and even undesirable if the application imposes excessive demands on resources of time and finance. Consistency of mass diagnosis is more important than accuracy and minor errors or oversights that occur randomly in all sub-groups examined do not interfere with the attainment of valid conclusions. (27)

Indices are designed for the purpose of recording numerical

occurrences and determining the relative severity of clinical conditions that are capable of quantification on a graduated scale. These indices should be in a form suitable for submission to statistical analysis for comparing mean prevalence and severity rates, and for determining the significance of differences.

The standardised methods used in this investigation for detecting and recording dental conditions were applied with speed and facility and fulfilled the other requirements to varying degrees.

One aspect of the study involved the investigation of caries prevalence, treatment received following past caries, and treatment required for the arrest and restoration of existing caries. The method adopted proved adequate for the complete fulfilment of this aspect of the study.

The usefulness, reliability and versatility of the D.M.F. tooth, the D.M.F. tooth surface, and the Boedecker Caries indices have been demonstrated and discussed on many occasions. Experience in the conduct of this survey confirmed that by disregarding all precavitation stages and applying criteria for the diagnosis of clinical stage caries only, reproducible results could be readily obtained. The indices assessed from these results revealed caries prevalence at the time of examination, life caries experience, teeth filled and tooth surfaces filled, teeth requiring treatment and tooth surfaces requiring treatment. From these indices annual caries incidence and treatment increments could be computed. The indices measured effectively

the intensity or severity of caries attack per person but failed to measure this factor per tooth or tooth surface. Some measure of the size of lesions could have reduced the need for exercising clinical judgement in determining treatment requirements but practical field methods for measuring the size of lesions have not yet been developed. The use of the Beodecker caries index increased the time required for examining, recording and computing carious lesions, and could be regarded as an unwarranted diagnostic refinement in view of the limited available resources of time and finance. On the other hand the use of this index facilitated the post-examination assessment of treatment requirements and obviated the need for retaining the subject in the chair for this procedure. From the epidemiological point of view the use of the Beodecker index could disclose valuable information on tooth surface distribution of caries, particularly in the low caries prevalent subjects. In the circumstances it was considered an effective index for this investigation.

Since the relationship between oral hygiene and certain types of periodontal disease is marked and uniform it is appropriate to discuss simultaneously the aspects of the investigation concerned with tooth brushing, oral debris, oral calculus oral hygiene and periodontal diseases.

No attempt was made to establish the extent to which information obtained by questionnaire about tooth brushing frequency might have been influenced by the subject's knowledge of dental public health recommendations. The questionnaires

were completed and returned before examination.

The examination of each mouth for oral debris and oral calculus followed the examination for caries and the time required to assess and score the extent of debris and calculus according to the defined criteria was no more than one and a half minutes. At this speed some individual flecks of sub-gingival calculus could have been overlooked but under the standardised examination conditions the resultant underscoring would have been random and uniform for all sub-groups examined. These two quantitative scores assessed individually and later compressed into a single oral hygiene index gave a simple and effective measure of individual or group oral hygiene status expressed in quantitative terms.

The examination of tooth supporting tissues followed and as the investigator had by this time surveyed the mouth three times this examination could be accomplished quickly and required no more than one and a half minutes in most cases.

The Russell Periodontal Index was applied without the use of radiographs. Criteria for this index accepted only positive signs as an indication of disease and the problem of questionable diagnosis was eliminated by the rule that instructed the examiner to assign the lower score when the diagnostic state was not clearly evident. The progressive scale provided for two stages of gingivitis and three stages of periodontal destruction depending of the presence of pockets, resorption of the alveolar crest, and tooth mobility.

For the consideration of adolescents and young adults in the 16-20 age group this scale appeared to be relatively insensitive for the incipient disease stages and weighted too heavily towards the destructive stages of periodontal disease. Many observed conditions, which by clinical assessment based on empiricism could be classified as pre-clinical or incipient disease states, just failed to score one on the Russell Periodontal Index. Clinical manifestations of these conditions included:- loss of tissue tone, loss of stippled appearance, generalized hyperaemia and oedema without specific sign of inflammation.

By adhering strictly to the criteria it was possible to apply the index simply and swiftly. Although basically a qualitative classification the quantitative element was adequate to provide both a measurement of prevalence and a measurement of severity for drawing comparisons.

The indices used for the assessment of oral debris, oral calculus, oral hygiene and periodontal disease gave no indication of the amount and nature of dental treatment this age group had received for these conditions. On the other hand a positive score for any of these indices represented a definite need for treatment but did not measure the amount required. Treatment needs assessed from these positive scores were however incomplete because the many subjects showing pre-clinical or incipient disease states which failed to score, were all in need of preventive treatment or curative treatment.

For the investigation of enamel opacities and enamel hypoplasias the methods were similar and proved efficient and effective in application. Precise criteria definitions allowed a rapid count of affected teeth and the degree to which the dentition was affected was readily assessed on a graduated scale. The resultant index was an adequate measure of both the prevalence and the severity of the defect and was suitable for inter group comparability. Treatment requirements could not be assessed from these indices.

The Ellis Classification of broken incisors is again basically a descriptive classification designed for clinical rather than epidemiological studies. However the quantitative element included in this classification proved satisfactory for the purpose of this investigation to allow not only the assessment of prevalence rates but also the assessment of relative severity for comparisons with other groups. The investigation revealed the number of broken incisors that had been treated and the number that required treatment.

The examination method also made provision for investigating the dental treatment needs of this age group in the fields of prosthodontics, orthodontics and surgery. Assessments made in respect of the needs for these types of treatments were based substantially on the subjective judgements of the investigator.

In assessing the needs for dental prostheses the examiner acknowledged that for the 16-20 year age group dentures were

required by all totally edentulous subjects. In addition he recognised that the partially edentulous state could constitute a physical disfigurement, a psychological handicap, a functional impairment or a hazard to the remaining oral tissues. The need for full dentures was readily assessed but time did not allow the complete oral evaluation required for a considered assessment of partial denture needs. Clinical judgement was exercised in determining whether existing dentures required replacement or repair. In some cases the examiners judgement was influenced by the expressed opinion of the subject.

In assessing needs for orthodontic treatment the examiner recognised that some dento-facial conditions could constitute physical, psychological or functional handicaps. Treatment needs were assessed by subjective judgement but the time available was once again considered inadequate for a rational assessment. No attempt was made to classify the dento-facial anomalies other than on the basis of whether or not treatment was required.

For assessing oral surgery treatment needs the examiner relied mainly on radiographic evidence. However X ray films were exposed only when the clinical appearance suggested the presence of an impacted tooth. It is assumed that under the survey conditions some impacted third molars remained undetected.

This examination has revealed that while the survey method proved both practical and efficient for the determination of the mean value of many dental attributes of this sample of

the N.S.W. 16-20 year population group, deficiencies in the sample design impose some restriction on the width of inference that can be drawn in assessing the dental health and treatment needs of the total N.S.W. 16 - 20 year population group, and in comparing the data that has been assembled with data relating to a similar population group in N.Z.

SUMMARY

The consideration of dental public health programmes in many countries throughout the world has focussed attention on dental survey methodology and the need for developing survey techniques that will simultaneously provide data required for epidemiological studies, for programme development and for programme evaluation.

A dental survey method designed for evaluating the effectiveness of a well established dental public health programme in New Zealand has been adapted for application in a survey of a population group in New South Wales.

The application of this method has been examined and discussed.

The method has proved practical and efficient but factors relating to the inadequacy of resources have imposed limitations on the width of inference that can be drawn from the assembled data.

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APPENDIX I

Location Code _____ Occupation Code _____ DENTAL CHART X-Rays taken ☐

RUSSELL PERIODONTAL SCORE															
CLINICAL															
X-RAY															
FINAL															
	7	6	5	4	3	2	1	1	2	3	4	5	6	7	
CLINICAL															
X-RAY															
FINAL															
Total		Teeth		Score											

ORAL SURGERY

Impacted third molar(s) present ☐Treatment required? ☐Number noted on clinical examination ☐Additional number noted on x-ray examination ☐Other minor condition requiring oral surgery ☐

Specify _____

Treatment required? ☐HANDICAPPING DENTOFACIAL ANOMALY ☐Treatment required? ☐Cleft lip ☐Cleft palate ☐Prognathism ☐Retrognathism ☐Crowding ☐Spacing ☐Deep overbite ☐Open bite ☐Other ☐

Specify _____

OTHER CONDITIONS AND COMMENTS _____

QUESTIONNAIRE

1. How many months is it since you last went to the dentist? _____ months.
2. Did you attend a dental nurse regularly as a child? (Yes or No) _____

IF THE ANSWER TO QUESTION 2. IS YES, COMPLETE THIS BLOCK:

- a. For how many years did you attend a dental nurse? _____ years.
- b. At what age did you stop being treated by a dental nurse? _____ years.
- c. Did you attend a dentist regularly after leaving the dental nurse? (Yes or No) _____
- d. Did you continue to attend the dentist regularly after the age of 15? (Yes or No) _____

IF THE ANSWER TO QUESTION 2. IS NO, COMPLETE THIS BLOCK:

- a. Did you attend a dentist regularly? (Yes or No) _____
- b. At what age did you start being treated by a dentist? _____ years.
- c. At what age did you stop being treated by a dentist? _____ years.