

Dental Caries: A Study of Regional Variations In New Zealand.

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INTRODUCTION.

THIS study was undertaken primarily to ascertain whether there was, in fact, any regional variation in the incidence and degree of dental caries in New Zealand, as has frequently been surmised from clinical observation. Analysis of the statistical evidence assembled did actually disclose certain significant variations as between different localities, and, in particular, between certain types of localities. Further statistical analyses were made, this time applied to various factors which seemed to offer promising fields for study in relation to their association with dental caries—rickets, occupational environment, infant feeding and child care, relative susceptibility of the sexes. Incidental reference is made to certain other factors that are receiving prominence to-day as possible factors in the etiology of dental caries.

The writer was fortunate in having the facilities of the New Zealand Department of Health at his disposal, and in having the ready co-operation of other Government departments. The willing assistance that was forthcoming from these and other sources is gratefully acknowledged.

BASIS AND PURPOSE OF THE INVESTIGATION.

The study is based on the dental and, in a proportion of cases, the medical examination of 1,475 children of school-entrance age (5-6 years) in 25 different localities, which were chosen for their diversity geographically, climatically, physically and economically.

Stated briefly, the objects of this study are:

- (i) Primarily to ascertain to what extent regional variations occur in regard to the incidence and degree of dental caries in New Zealand, and
- (ii) To study, statistically, the effect of some environmental factors, both extrinsic and intrinsic, on such regional variations as are shown to exist.

As with all such studies, the ultimate object is to gather and sift the available material in the hope that some contribution, however small, may be made to our knowledge of the cause and prevention of dental caries.

THE METHOD ADOPTED.

Twenty-five centres were selected for study, extending from Whangarei in the north to Invercargill in the south. The localities were chosen as being representative of all parts of the Dominion, including farming, industrial, fruit growing and coal mining areas,

in addition to typical town and city residential areas of varying economic status. In each area the new school entrants for the year were examined, that is, children in the 5-6 year age group. In most cases the group included all the new entrants for the period, thus reducing the possibility of deliberate or unconscious selection to a minimum. The new school entrants were selected because any later age group would be receiving regular dental attention from the School Dental Service, and consequently would not present such a favourable field for study. The dental examinations of the 1,475 children were made by officers of the School Dental Service, in accordance with detailed instructions designed to secure uniformity, and a caries index was calculated for every child in accordance with a formula evolved by the writer. An endeavour was made to have a general physical examination made in each case, but this proved only partially successful, and the number who were medically examined was relatively small.

REGIONAL VARIATIONS OBSERVED.

An analysis of the mean caries indices for the twenty-five localities did actually disclose a significant variation in the incidence and degree of dental caries. The mean regional caries indices were found to vary between 5.9 and 17.4, with a grand mean of 10.2 (see Fig. 1). The group of localities with the lowest mean caries indices consisted of (commencing with the lowest)—Roxburgh, Hamilton, Oamaru, Waipukurau, Ruawai, Tauranga and Whangarei, all of which can be described in general terms as centres of thriving farming areas. The group with the highest mean caries indices was (commencing with the highest)—Denniston, Huntly, Kaitangata, Invercargill, Ponsonby, Woolston and Millerton. Of these seven centres, four, including the three with the highest mean caries indices, are coal mining centres; two are what might be described as industrial suburbs of large cities, while the seventh, Invercargill, appears at first sight to be misplaced, as it, too, is the centre of a large farming district; but it also has a certain industrial population, and on scrutinising the occupations of the fathers of the children examined, it was obvious that a large proportion of the children had come from this section of the community.

Thus it was evident that the incidence and degree of dental caries did, in fact, vary as between the localities investigated. Moreover, by analysing the factors that enter into the calculation of the caries index, it was demonstrated that the percentage of children affected was uniformly high in all localities, and that the variations were to be found in (a) the percentage of teeth affected, and (b) the degree of tooth destruction.

THE COAL MINING LOCALITIES.

As the coal mining localities figured so prominently in the high caries index group, the statistics were further analysed with a view to determining whether the caries indices for these areas were significantly higher than for the non-coal mining areas. A table showing the frequency distribution of the 1,475 children in caries index groups revealed that there were comparatively few children with a caries index above 25. The actual number was 102 out of

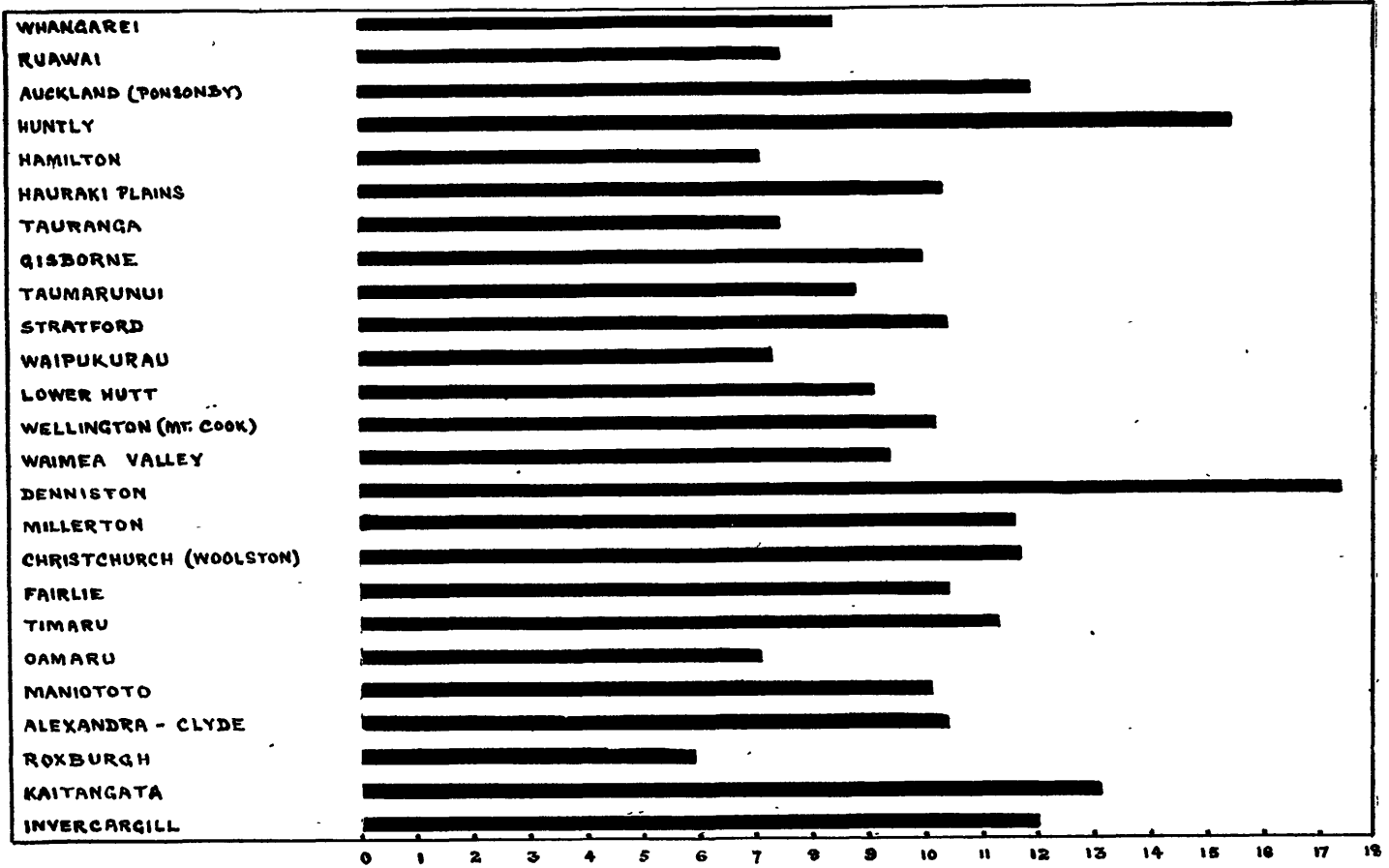


FIG. 1.—Illustrating regional variations in the incidence and degree of dental caries, as indicated by the mean caries indices for 25 localities, based on the dental examination of 1,475 children aged 5-6 years.

the sample of 1,475, or 6.9 per cent. In the four coal mining areas taken together there were 147 children, of whom 25 had a caries index above 25, or 17 per cent., as against 5.8 per cent. for the non-coal mining areas. Table I shows the frequency distribution as between coal mining and non-coal mining areas. Stated in another way, at the rate of 6.9 per cent. for the whole sample, it could reasonably be expected that the same proportion of the coal mining groups, that is, approximately 10 children, would have a caries index of 25 plus, but instead of 10 there were actually 25 in this high category.

In order to test the statistical accuracy of the above statement, the Chi-squared test was applied, and showed a highly significant result.

SOME POSSIBLE CAUSATIVE FACTORS.

Lack of Sunshine.

A possible physical factor is the prevalence of fogs, with the consequent exclusion of sunshine, affecting alike the riverside towns of Huntly and Kaitangata, and the high altitude townships of Denniston and Millerton. Through the courtesy of the Government Meteorological office, a table showing the hours of sunshine per annum for places throughout New Zealand was made available. While observations had not been made actually at these coal mining centres, statistics were available for four of the seven localities with the lowest mean caries indices, and for three of the seven with the highest. These figures showed the average hours of sunshine per annum over a period of five years, and the averages for the two sets of localities (low and high caries index) disclosed a difference of only 92.7 hours per annum, or about 15 minutes per day. This could scarcely be regarded as significant in a country with a temperate climate, where normally only the face and hands are exposed to the sun. Observations made at the actual coal mining centres would, however, be of interest.

Fluorine.

Much has been written, particularly in recent years, in regard to the influence of fluorine in the control of dental caries. It has been suggested that one part in a million in drinking water will confer increased immunity to caries. The limited number of analyses that are available show that the fluorine content of New Zealand waters is much lower than the optimum amount suggested, and this appears at first sight to support the hypothesis that lack of fluorine may be a factor in our high incidence of dental caries. We cannot overlook the fact, however, that the pre-European Maori had excellent teeth, and, according to Pickerill (1), was more immune to caries than any other race for which statistics are available. The Maoris drank the water from New Zealand streams and rivers, and gained their living off the soil, and there is no evidence to show that the fluorine content of New Zealand waters to-day, or the mineral content of the soil, is substantially different from what it was in pre-European days. Thus, while the low fluorine content of New Zealand waters may be a contributing factor, it is clearly not the only factor to account for the high incidence and degree of dental caries in this country.

Rickets.

The medical reports in this survey showed that an abnormally high proportion of the children at one of the coal mining centres exhibited gross manifestations of rickets. Now, M. Mellanby (2) and others have claimed that an association exists between the incidence of rickets and that of dental caries. Other workers refute this hypothesis, and say that there is no evidence of any correlation between the two conditions. Here, then, was an opportunity to test the conflicting theories under local conditions. Statistics were analysed in the case of 164 children who showed signs of rickets, and the result was that no correlation could be demonstrated between the incidence of rickets and that of dental caries, as far as the children who formed the subject of this study were concerned. More than half of the children with stigmata of rickets had teeth better than the average, and in several cases where the rachitic manifestations were described as slight, the caries indices were high. Similar results have been obtained in other countries, notably by Taylor and Day (3) in India.

Occupational Environment.

The very nature of the coal mining industry tends to produce an environment in which many of the ordinary amenities of life may be absent, and which may tend to have an adverse affect upon the mode of life of those who have to live in coal mining areas.

Vernon (4) is of the opinion that the three factors of heredity, social environment and occupational environment are closely interlocked—heredity in that an individual who inherits a high standard of intelligence is better fitted to cope with risks to health; social environment (in which he includes nutrition) in that good home environment and wise selection of food play a vital part in the maintenance of health; occupational environment in that this influences to a considerable extent the mental outlook of the individual and determines his economic status. Thus the three factors are mutually dependent upon one another.

Is it possible, then, that these factors can have any influence on the incidence and degree of dental caries?

The data included the occupation of the fathers of most of the children examined, and on studying the list of occupations it was evident that they could conveniently be grouped under five headings—

- (1) Manual occupations.
- (2) Farming.
- (3) Clerical work.
- (4) Trading.
- (5) Professions.

The occupations of the fathers were classified accordingly in 1,285 cases, and the mean caries index for each occupational category was calculated. This analysis disclosed a significant difference in the dental condition of the children in two categories in particular, namely, manual workers and professions. The children in the manual worker group had the highest mean caries index

(10·8), and those in the professional group the lowest (6·3, or excluding one isolated case, 4·6). Similar observations have been made by Wilkins (5) in England and by Greenwald (6) in the United States. Considered in relation to Vernon's hypothesis quoted above, the reason is perhaps to be found not in any one factor but in a combination of factors connected with environment.

Infant Feeding and Child Care.

In view of the almost universal adoption of the Plunket (or Truby King) system in New Zealand [78 per cent. of the babies born in New Zealand in 1942-43 came under the supervision of Plunket nurses (7)], the question of infant feeding and child care in relation to dental caries was also studied, but the number of children for whom we had the necessary data was somewhat limited—390 in all. The duration of breast-feeding and of Plunket supervision respectively were ascertained from the mothers in the course of the medical examination of the children, and the statistics were analysed. Of the 390 children seven had perfect teeth (cf. 31 with no caries in the whole group of 1,475 children), but it was observed that these had had the longest average period of Plunket supervision, and when the results were plotted in graph form, it was noted that the duration of Plunket supervision tended to fall as the caries index rose. The

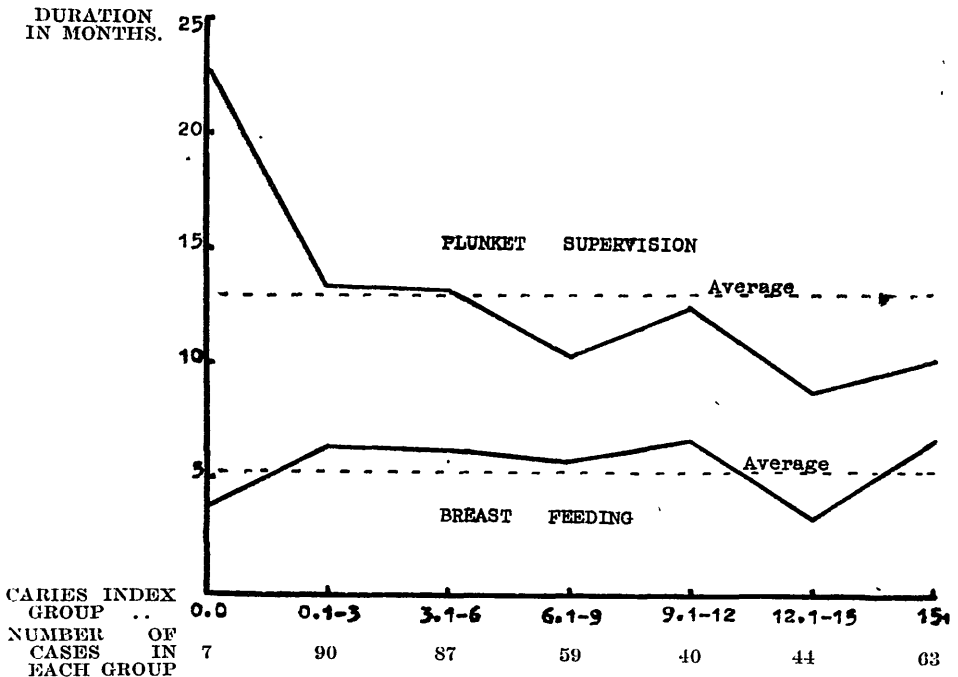


FIG. 2.—Breast feeding and Plunket Supervision in relation to caries-index groups in 390 cases in age-group 5-6 years.

breast-feeding graph, on the other hand, although it showed minor variations, disclosed a considerable degree of uniformity

in regard to the duration of breast-feeding, irrespective of variations in the caries index (see Fig. 2). This, however, should not be interpreted as indicating that breast-feeding does not confer increased immunity to dental caries (and the Plunket system stresses the prime importance of breast-feeding). In the age-group in question, ante-natal conditions will have had more influence than breast-feeding on the structure of the teeth. Nevertheless, lack of breast-feeding may be a contributing factor in the onset of caries in later childhood through its influence on the structure of the permanent teeth, as well as in the resulting tendency to under-development of the jaws, with consequent irregularity of the teeth. The explanation of these observations would appear to be that the Plunket system has as its central feature a carefully arranged nutritional programme which must be followed with care, as it has to be modified from time to time according to age and progress. This programme, with all its associated features concerning the general welfare of the child, demands close attention, intelligence, self-discipline and patience on the part of the mother. Taking these facts into consideration, the evidence can be said to suggest that the application of sound dietary principles, involving the intelligent selection of foodstuffs, and carried out in accordance with a carefully prepared plan, is associated with a reduction in the incidence and degree of dental caries.

Relative Susceptibility of the Sexes.

A study of the dental condition of 747 males and 728 females in the age-group 5-6 years disclosed no significant difference in the average caries index as between males and females (10.3 for males and 9.9 for females).

The average number of teeth affected per head proved to be the same (10.8) for both males and females.

It can be assumed, therefore, that this is not a factor that has any bearing on the regional variations that have been demonstrated.

CONCLUSION.

The evidence shows that regional variations in the incidence and degree of dental caries do actually exist in the age group in question, and that the variable factors are the percentage of teeth affected and the degree of tooth destruction. The percentage of children affected by dental caries is uniformly high. The study of possible causative factors points to the wise selection of food as a factor in controlling dental caries. Intelligent and organised food planning appears to be associated with a low caries index, while a high caries index is found in conditions which suggest indifferent application of dietary principles.

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TABLE I.
Dental Examination of 1,475 School Entrants (Age Group 5-6 Years) in 25 Different Localities

FREQUENCY DISTRIBUTION											
In Caries Index Groups: Coal Mining and Non-coal Mining Localities.											
Caries Index Group ..	0.0	0.1-5	5.1-10	10.1-15	15.1-20	20.1-25	25.1-30	30.1-35	35+		
Distribution, All Localities 1,475 cases	31	503	351	241	143	104	63	24	15		
Theoretical Distribution Coal Mining Localities 147 cases	3	50	35	24	14	10	6	3	2		
Theoretical Distribution Non-coal Mining Localities 1,328 cases	28	453	316	217	129	94	57	21	13		
Actual Distribution, Coal mining Localities .. 147 cases	3	24	33	26	22	14	12	7	6		
Actual Distribution, Non- Coal Mining Localities 1,328 cases	28	479	318	215	121	90	51	17	9		
Percentage Distribution Coal Mining Localities —	2.0	16.3	22.4	17.7	15.0	9.5	8.2	4.8	4.1		
Percentage Distribution Non-Coal Mining Localities —	2.1	34.1	23.8	16.3	9.7	7.1	4.3	1.6	1.0		

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