

# DIABETES MELLITUS AND PERIODONTAL DISEASE IN MALTA

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In differing parts of the world diseases of the teeth and of their supporting structures assume roles of varying importance according to prevalence and severity. Although neither as yet can be totally prevented or cured the more advanced countries have shown that preventive measures, undertaken energetically, are effective in lowering the incidence of dental caries and of periodontal disease.

In Malta public dental health and education are still in their infancy. A low incidence of dental caries as compared with some other countries is probably due to naturally occurring fluoride of almost optimal concentration in the water supplies. However it has also been shown that the oral soft tissues are attacked early and predispose to the periodontal pathology that is common in the adult population and that presents as the Island's major dental health problem (Olivieri-Munroe, 1968). This has been further confirmed by the fact that after 30 years of age, causes of tooth loss are predominantly periodontal (Camilleri, 1966).

The aetiology of periodontal disease is complex but primarily extrinsic in nature. Neglect of oral hygiene, and formation of supra- or sub-gingival calculus play a large part in its causation. However, the soft tissues of the mouth are in no way

unique and are also influenced by systemic factors that can affect the body tissues in general. These include hormonal, dietary and other factors and many have been implicated in the causation of or predisposition to periodontal disease, or merely in altering the oral tissues response to local injury. In this context, the possible role of diabetes mellitus is of great interest especially in these Islands where it has been shown that its incidence is high (Zammit Maempel, 1965).

The effects of diabetes on the health of the oral cavity have been much debated. Of the more recent investigations, Sandler and Stahl (1960) found a significantly higher prevalence of periodontal disease in patients with diabetes. Belting *et al.* (1964) noted that the severity of periodontal disease among diabetic patients was significantly greater than among non-diabetics and concluded that this was another manifestation of the peripheral vascular occlusive disorders associated with this condition. Stahl *et al.* (1962) found by gingival biopsy that peripheral vascular changes were to be found, with increased thickening of arteriolar walls and decreased lumen size. These findings were confirmed and extended to pre-diabetes by McCullen *et al.* (1965). Animal experiments by Cohen *et al.* (1966) produced

similar results. Using Chinese hamsters with spontaneous hereditary diabetes he observed that severe periodontal changes appeared earlier in life and were of longer duration.

On the other hand, Ray and Orban (1950) found no correlation between severity of gingivitis and state of control of diabetes. Shannon and Gibson (1965) also could not relate periodontal disease with glucose tolerance in their study.

It would appear that opinion today is inclined to deny diabetes a cause and effect relationship in periodontal pathology; however it would seem that this systemic disorder can modify and probably accentuate the gingival or periodontal lesion initiated by local injury or irritation, by alteration in the host's resistance or repair potential to local injury (Stahl, 1966).

Diabetes mellitus is of some importance in dentistry. As already seen, its possible role in the aetiology of periodontal disease is still under investigation. Lowered tissue resistance to trauma or infection make this type of patient a possible hazard when undertaking oral surgery under local anaesthesia. The metabolic instability of such patients makes the necessity for general anaesthesia even more hazardous. It has also been postulated that dental treatment by elective periodontal surgery or tooth extractions where indicated and subsequent eradication of chronic inflammatory processes in the mouth may lead to a decreased insulin requirement in some patients (Williams and Mahan, 1960; D'Ingianni, 1946). Furthermore, a knowledge of the oral symptomatology of this disorder may be useful in helping to diagnose the undetected diabetic and referring him for suitable medical treatment.

In view of the high incidence of diabetes in Malta, a study of patients attending the Diabetic Clinic, St. Luke's Hospital has been in progress since 1964. The objects of this study had been to ascertain the role of the disease in conditions of the mouth and in the incidence of complications following oral surgical procedures and their prevention.

This particular report is restricted to

diabetes and periodontal disease. A further study dealing with oral symptomatology in this disease and associated radiographic bone changes has also been completed.

### Materials and methods

The number of patients examined is seen in Table I. Juvenile diabetics were few and this report has been restricted to 166 patients from 40 to 60 years. These were all under treatment at the Diabetic Clinic and were referred to the Dental Department, St. Luke's Hospital for routine examination or at their own request for some aspect of dental treatment.

TABLE I

Total number of diabetic patients examined

| Age   | Males | Females | Combined |
|-------|-------|---------|----------|
| 30-39 | 18    | 14      | 32       |
| 40-49 | 21    | 43      | 64       |
| 50-59 | 38    | 64      | 102      |
| 60-69 | 21    | 47      | 68       |
| 70-79 | 5     | 6       | 11       |
|       | 103   | 174     | 277      |

All patients in this study were examined by one investigator under standard dental conditions. In order to avoid any bias the diabetic status of each patient was not known until after the study was complete. The teeth were charted by the D.M.F. method for dental caries (W.H.O., 1962). Periodontal conditions were scored by the Russell (P.I.) index (Russell, 1956). Periodontal disease was further assessed by recording mobility of the teeth (Sheridan *et al.*, 1959) and recession of the gingival margin to or beyond the cemento-enamel junction (Stahl *et al.*, 1955). Tooth brushing habits were recorded. Attendance for past dental treatment was grouped under the following heading: "never, emergency only, or regular visits".

Some of the patients examined required treatment involving dental extractions. These were carried out by one operator under local anaesthesia (Lidocain hydrochloride with epinephrine 1:50,000).

The number of occasions on which "dry socket" followed extraction was recorded as an example of post-operative complication and related to fasting blood sugar levels. Dry socket was diagnosed as present in cases of severe pain three to four days after extraction, together with a necrotic or absent blood clot in the tooth socket, bare bone or interdental septa and foul odour.

The condition of the periodontal tissues as shown by the P.I. results was related to the following data obtained from the patients' records in the Diabetic Clinic, namely:

1. length of known diabetes.
2. type of diabetic therapy, i.e.
  - (a) diet only
  - (b) oral hypoglycaemic drugs
  - (c) insulin
3. obesity.
4. fasting blood sugar.
5. two-hour blood sugar.
6. presence of diabetic complications.

The fasting blood sugar and two-hour blood sugar figures were obtained from glucose tolerance tests performed in the Pathology Department, St. Luke's Hospital by Harding's titrimetric method as modified by Asatoor and King. (Harding and Downs, 1933; Asatoor and King, 1954). Diabetic complications were recorded under three broad headings, namely, retinopathy, nephropathy, and neuropathy. The diagnosis of retinopathy, following examination by the Ophthalmology Department was based on the presence of microaneurisms, haemorrhages or exudates; of nephropathy by proteinuria and of neuropathy by symptoms of pain or tingling of the extremities, vibratory sense impairment or decreased to absent deep tendon reflexes in the lower extremities.

### Results

The relationship between duration of diabetes and periodontal disease were studied. The results are shown in Table II. There appeared to be little relation between these two factors, with high P.I. values obtained for the shortest and the longest duration of diabetes.

**TABLE II**  
The incidence of periodontal disease (P.I.) in diabetic patients 40-59 years old, grouped according to the duration of the general disease

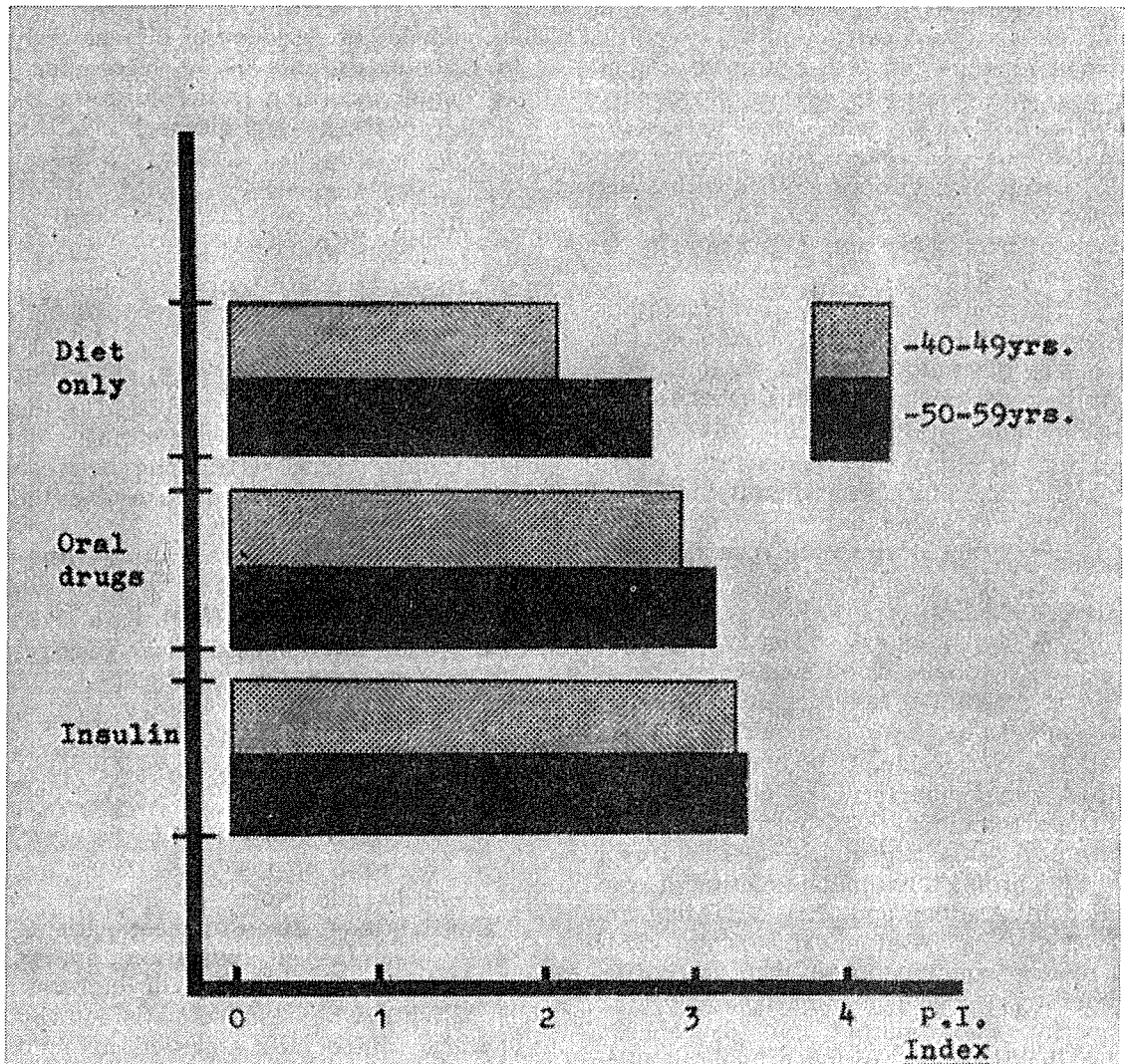
| <i>Duration of diabetes</i> | <i>P.I. Index</i> |
|-----------------------------|-------------------|
| 0 - 6 months                | 3.0               |
| 6 m. - 4 years              | 3.1               |
| 5 - 9 years                 | 2.6               |
| 10 - 14 years               | 2.7               |
| 15 - 19 years               | 1.8               |
| 20 years +                  | 4.0               |

Obesity, a common finding in this metabolic disorder, was also related to the P.I. index (Table III) but again there appeared to be no direct relationship between incidence of periodontal disease and the weight of diabetic patients.

**TABLE III**  
The incidence of periodontal disease (P.I.) in diabetic patients aged 40-59 years, grouped according to obesity

| <i>Obesity</i>     | <i>P.I. Index</i> |
|--------------------|-------------------|
| normal to + 5 lbs. | 2.9               |
| + 6 to 15 lbs.     | 3.0               |
| + 16 to 25 lbs.    | 2.8               |
| + 26 to 35 lbs.    | 2.8               |
| + 36 to 45 lbs.    | 3.9               |
| + 46 lbs. and over | 3.0               |

The treatment given to these patients is often taken as an indication, among others, of the severity of their diabetes. Thus patients who respond satisfactorily to dietary control are regarded as mild diabetics with those on insulin therapy on the other end of the scale. Patients receiving oral hypoglycaemic drugs would fall into an intermediate position. Under these three headings (Figure 1) the patients were divided into two groups, those of 40-49 and 50-59 years. Treatment of diabetes was then related to periodontal disease. In both age groups there appeared a definite gradient of periodontal severity, being mildest in those under dietary control only and most severe in those receiving insulin. The oral condition in those receiving oral hypoglycaemics fell in between these extremes. A consistently higher P.I. score was also obtained in the older group of patients as compared with the 40-49 group.



**Figure 1: The incidence of periodontal disease, (P.I.) in patients aged 40-49 and 50-59 years grouped according to treatment for diabetes mellitus.**

Another index of diabetic severity is the level of blood glucose. For this purpose, the fasting blood sugar and two-hour blood sugar were utilised. In Figure 2 the P.I. index was related to the fasting blood sugar in patients from 40 to 59 years. As values for blood-sugar rise there is a steady increase in the incidence of periodontal disease with a peak of 5.0 (P.I.) occurring at the maximum blood sugar level of 270mg./100 ml. Fairly similar results were obtained for the two-hour blood sugar values (Figure 3). The peak in periodontal severity was reached only with the

peak in sugar values (P.I., 3.8 and two-hour sugar value of 360-399mg./100 ml.). Thus in both cases the level of blood sugar appeared to be related to the severity of periodontal disease.

It was also attempted to relate the incidence of periodontal disease to that of diabetic complications. The complications were grouped under the three headings of retinopathy, nephropathy, and neuropathy. The P.I. index was related to none, to one, or to two or to more of these groups of complications (Figure 4). A small but definite rise in P.I. values was

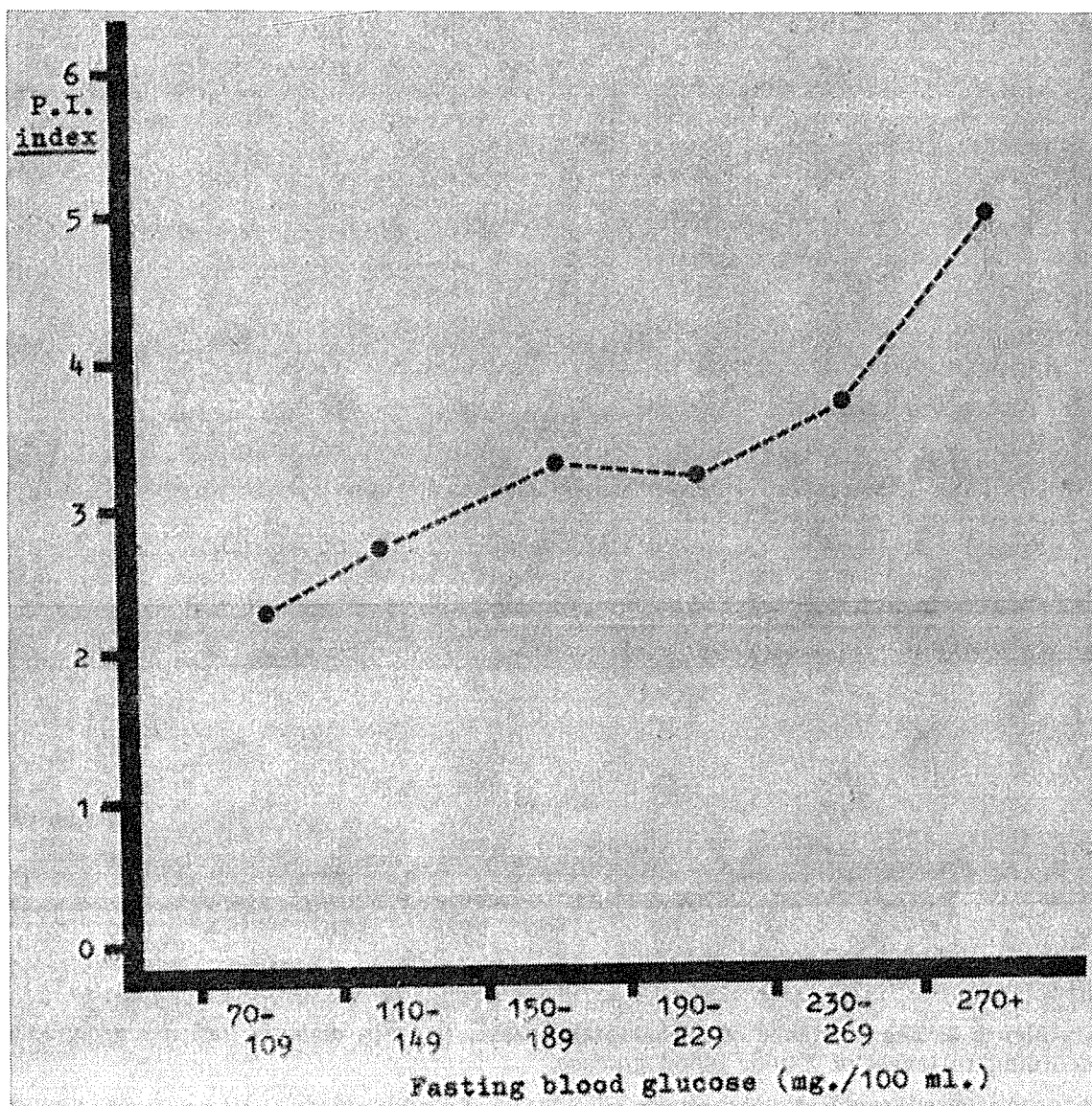


Figure 2: The incidence of periodontal disease, (P.I.) in diabetic patients grouped according to levels of fasting blood glucose. Patients aged 40-59 years.

obtained in patients with one type of complication as compared to those with none and this became a marked rise in those with two or more complications.

The number of dry sockets that developed after dental extraction is seen in Table IV, related to levels of fasting blood sugar.

The whole series of 227 patients (30 to 79 years) were routinely examined for incidence of dental caries. In view of the fact that D.M.F. figures for adults in

TABLE IV  
Number of "dry sockets" occurring following tooth extraction in patients grouped according to levels of fasting blood sugar

| No. of extractions | Dry sockets | Fasting blood sugar |
|--------------------|-------------|---------------------|
| 25                 | 4           | 110 mg./100 ml.     |
| 36                 | 6           | 110-160 mg./100 ml. |
| 26                 | 1           | 160-210 mg./100 ml. |
| 14                 | 0           | 210-260 mg./100 ml. |
| 11                 | 1           | 260 + mg./100 ml.   |

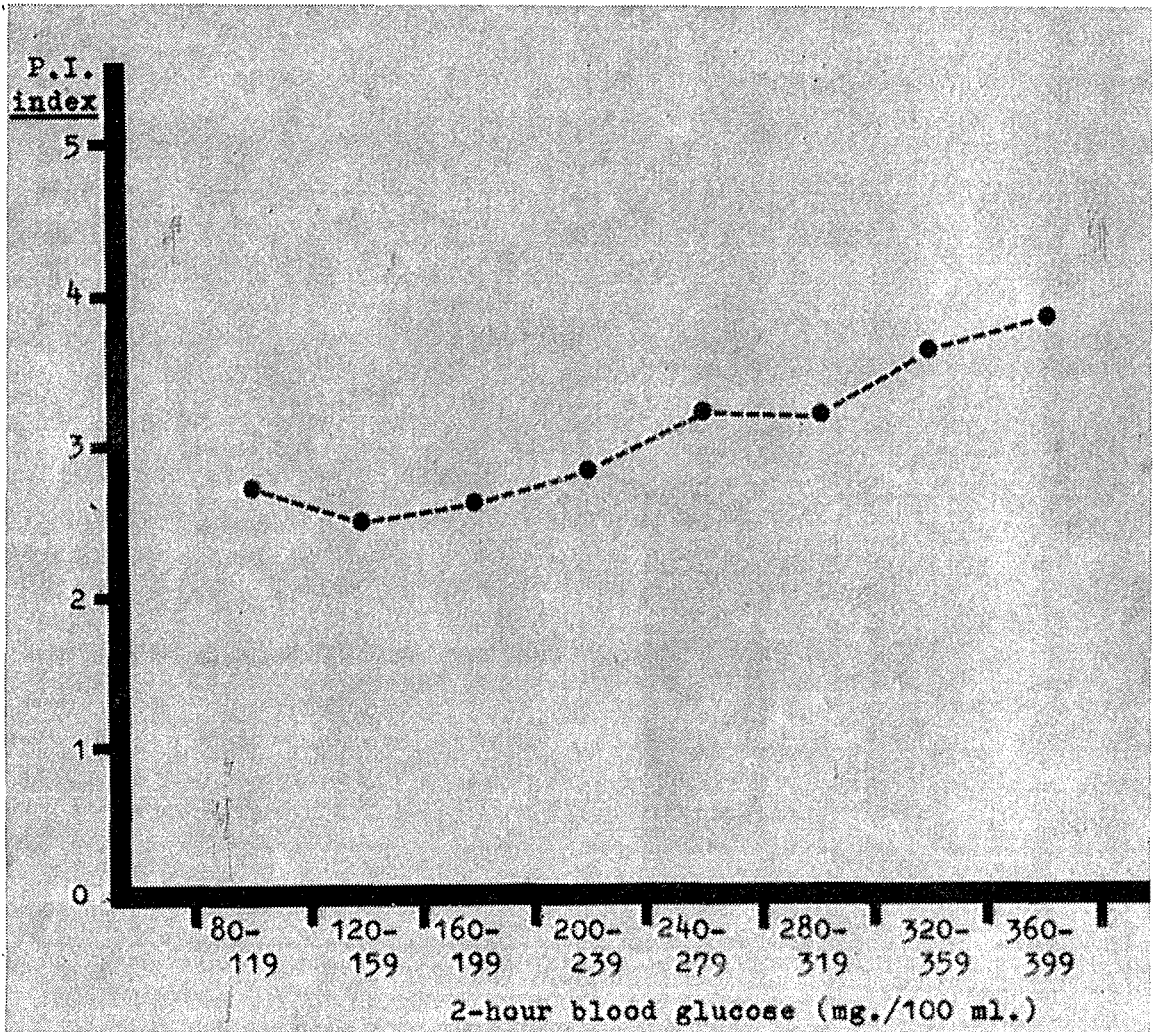


Figure 3: The incidence of periodontal disease, (P.I.) in diabetic patients grouped according to levels of 2-hour blood glucose.

Malta are not yet available, the results have been included in this report (Table V). A relationship between diabetes and dental caries has not been demonstrated and it is reasonable to assume that these figures are very broadly representative of the population even coming from such a specialised sample.

### Discussion

Some investigators in this field have attempted to classify diabetics into various groups, such as mild, moderate or severe. This simplifies matters to some extent but

TABLE V  
The D.M.F. levels in male and female diabetic patients aged 30 to 79 years

| Age   | D.M.F. |         |
|-------|--------|---------|
|       | Males  | Females |
| 30-39 | 11.2   | 9.6     |
| 40-49 | 12.9   | 11.9    |
| 50-59 | 15.1   | 15.4    |
| 60-69 | 17.9   | 19.9    |
| 70-79 | 23.0   | 16.5    |

is open to some criticism as it is relatively easy to group the very mild and the very severe cases but it can be difficult to fit in the ones in between. In this study it

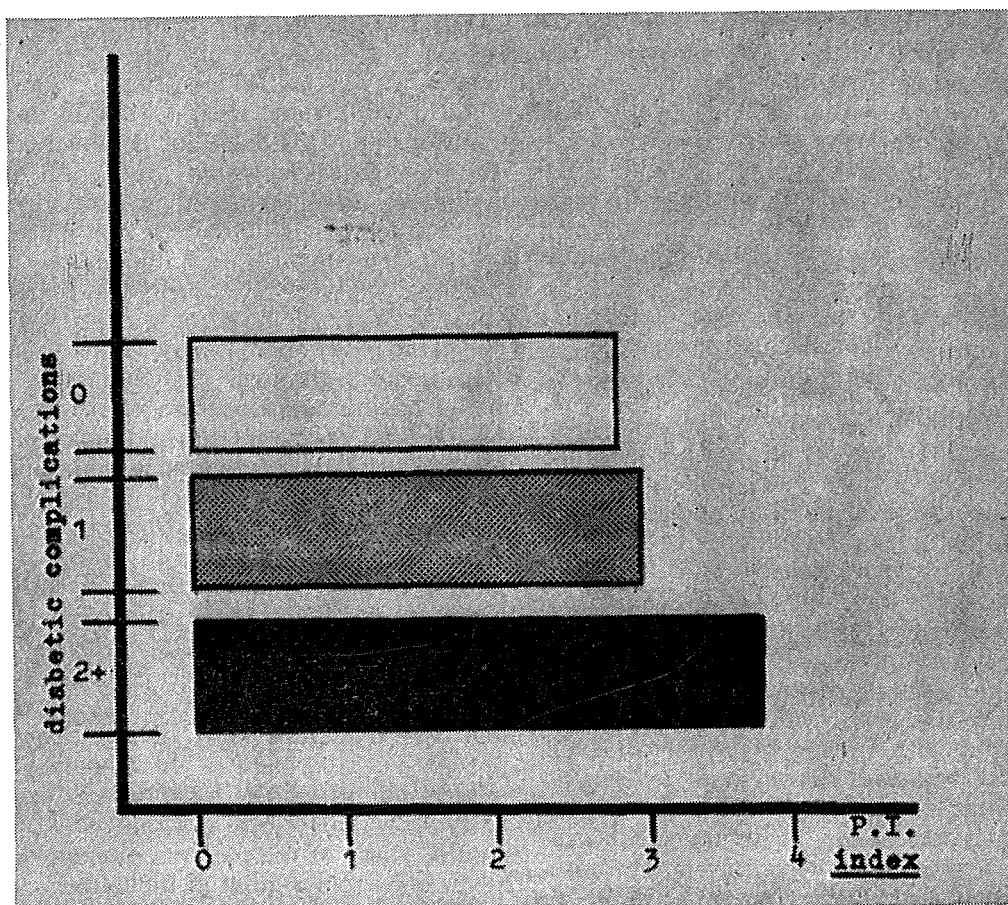


Figure 4: The incidence of periodontal disease, (P.I.) in diabetic patients manifesting 0, 1, or more than 2 types of general complications. — Patients aged 40-59 years.

was decided not to attempt any such classification of patients. The periodontal status was compared to individual findings such as blood sugar, without any grouping of patients into classes.

It was not possible to relate periodontal disease to duration of diabetes. Finestone and Boorujy (1967) obtained higher P.I. values in patients with a longer duration of the general disease. However, duration of a disease in patients of varying age can produce results which are not always strictly comparable. Moreover, periodontal disease is well known to increase in prevalence and severity with age, while on the other hand, younger diabetics commonly have a more severe diabetes, perhaps adversely affecting the

oral condition. It would appear that duration may be a factor of importance but should be studied in as restricted an age group as possible in order to produce results from which conclusions may be drawn.

Obesity is a common finding in mature onset diabetes, which is also the form of the disease most prevalent in Malta (Zammit Maempel, 1965). Marked obesity in these patients is often accompanied by greater difficulty in the control of their diabetes. With this in mind their periodontal status was related to obesity, but without conclusive results.

The treatment given for diabetes was taken as a further indication of severity. Finestone and Boorujy (1967) found the

degree of P.I. in these patients to be the same whether treated by insulin, oral hypoglycaemic drugs or diet only. In this study the P.I. obtained in those treated with insulin was higher than in those treated with oral hypoglycaemic drugs and this again was higher than in those under dietary control only. This was true for both the groups of patients aged 40-49 and 50-59 years. This finding would appear to indicate that the oral status may be related to the severity of the general disease, a fact of importance in the treatment planning of such patients.

Blood sugar levels and periodontal disease levels have been investigated by many workers. Cheraskin and Ringsdorf (1965) obtained a definite relationship between gingival disease and hyperglycaemia. Finestone and Boorujy (1967) obtained a marked rise in P.I. values with increasing blood sugar levels. In the 40-59 year-old patients observed in this study, a definite rise in P.I. values occurred when compared with fasting blood sugar levels and with two-hour blood sugar levels. Results were more marked in the case of the fasting blood sugar. A tentative conclusion that merits further study is that careful control of hyperglycaemia in these patients may lessen the component that diabetes adds to periodontal disease and consequently its severity and perhaps response to treatment.

In view of the degenerative changes observed in the supporting tissues of the teeth in diabetes (Stahl *et al.*, 1962; McCullen *et al.*, 1965) it has been suggested that the oral condition can be regarded as yet another diabetic complication. Finestone and Boorujy (1967) suggested that some factor in diabetes predisposes to degenerative complications and may be influential in the pathogenesis of periodontal disease. In his study, higher P.I. scores were obtained in patients with more diabetic complications. Similar results were obtained in this investigation where the complications were grouped in the same way. If this finding can be taken at face value, then investigation of patients with severe periodontal disease may be of value in diabetes detection.

No relation was demonstrated between the incidence of "dry socket" and levels of fasting blood sugar. Sheridan *et al.* (1959) also failed to obtain such a relationship. This does not however, mean that a higher incidence of dental post-operative complications is excluded in diabetics as compared with non-diabetics. A further investigation including non-diabetic controls is in progress.

This preliminary study seems to agree with results obtained elsewhere that diabetes has an influence on the course of periodontal disease. Oral pathology of the gingival tissues in Malta is found early even in children of three years of age (Mangion and Olivieri-Munroe, 1968). This progresses steadily to frank periodontal disease in early adult life and is a major cause of tooth loss in the mature adult. Caries has been shown to be low in comparison with other countries. The diabetic patient presents a special problem and demands early dental care and preventive treatment if his general disease is not to tip the balance and lead to early loss of teeth and an edentulous mouth. Many of the patients examined had never been to a dentist in their lives, while over 90% had attended only for emergency dental extractions or for provision of a dental prosthesis. Conservative treatment was virtually nil. None of the 227 patients had ever attended for routine dental care. There are moreover a large number of undetected diabetics who are unaware that they should give greater attention to their periodontal health. A recent study has shown that for every known diabetic in Malta, there is one undiagnosed (Zammit Maempel, 1965).

The concept that diabetes can affect even indirectly the prognosis and course of periodontal disease is of importance in public health dentistry especially in areas such as Malta where there is a simultaneous high prevalence of both conditions. Diabetic patients should be sought out and should receive preventive treatment and dental education, if their masticatory apparatus is to be preserved into late adult life.



## Summary

1. The role of diabetes mellitus in the causation of periodontal disease is discussed and investigated in 227 patients, all under treatment for the disease.

2. No relationship was shown to exist between duration of diabetes and obesity, as compared with periodontal disease.

3. The periodontal disease in patients under insulin therapy was more severe than in those receiving oral hypoglycaemic drugs and least severe in those under dietary control only.

4. Patients with higher levels of fasting or two-hour blood sugar showed a more severe periodontal condition.

5. Patients with a higher incidence of general diabetic complications also manifested higher P.I. levels.

6. No relationship between the incidence of "dry socket" following tooth extraction and fasting blood sugar levels could be demonstrated.

## Acknowledgements

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