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A relationship between periodintal disease and selected systemic conditions: review of previous stufies and an analysis of data based on a probability sample of the U.S. white adult population aged 18-79 years;

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IN THIS REPORT are presented estimates of the prevalence and severity of periodontal disease among U.S. white adults by levels of blood pressure, blood glucose, serum cholesterol, and other selected examination findings. Both actual and expected (age-adjusted) levels are presented so that differences between them can be examined for evidence of an association between periodontal disease and various systemic conditions.

Estimates in this report are based on examinations conducted by the Health Examination Survey during 1960-62 on a probability sample of U.S. white adults aged 18-79 years, selected from the civilian population at large. The estimates include approximately 78 million white men and women. The prevalence and severity of periodontal disease are measured by the Periodontal Index.

Among the findings that are briefly described are the following:

Women with hypertension have significantly more periodontal disease than those whose blood pressure was not pathologically elevated.

The prevalence and severity of periodontal disease rise with increasing levels of both diastolic and systolic blood pressure.

People whose peripheral pulse could not be palpated have more periodontal disease than those with palpable pulses.

Increased light reflex is associated with higher than expected periodontal scores.

A trend toward higher periodontal scores among women is associated with an increasing number of nervous symptoms.

Men who were diabetic or whose blood glucose level exceeded 208 mg.% tend to have relatively higher prevalence and severity of periodontal disease.

No relationship between periodontal disease and serum cholesterol is apparent.

The general trend that prevailed among many estimates suggests that the prevalence and severity of periodontal disease are associated with various systemic findings, especially those indicative of chronic vascular disease.

SYMBOLS

Data not available	---
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SELECTED EXAMINATION FINDINGS RELATED TO PERIODONTAL DISEASE AMONG ADULTS

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INTRODUCTION

In a previous report the Health Examination Survey estimated the prevalence among U.S. adults of inflammatory disease of the anatomic structures that support teeth.[1] Based on examinations conducted during 1960-62, the estimates underscore not only the high prevalence of periodontal disease but also its wide range of distribution throughout the United States. About 44 million adults aged 18-79 years had gingivitis without obvious pocket formation, the report estimated, and about 23 million had chronic destructive disease with one or more pockets diagnostic of advanced periodontal disease. Distinct patterns of distribution prevailed: more disease was generally present in older people than in younger ones, in men than in women, and in Negro adults than in white. In addition, men and women who were economically and educationally more advantaged usually had less periodontal disease than others.

Oral hygiene among sample men and women who had one or more of six specified teeth was also evaluated.[2] As foreseen, both the prevalence and severity of periodontal disease increased as oral hygiene worsened. Demographic differences in the distribution of periodontal disease were either largely or fully leveled when allowance was made for variations in oral hygiene. However, among people with equivalent levels of oral hygiene, older men and women had more periodontal disease than younger men and women. Briefly, both age and oral hygiene emerged as important factors, each of which was related independently of the other, in the prevalence and severity of periodontal disease.

Periodontal disease is a pathologic process which, if ignored, progressively invades and destroys the tissues and structures that support the teeth. Gingivitis is inflammation of the gums. Breakdown of the deeper structures—periodontal fibers and alveolar bone—is attributed to two disease processes, one inflammatory in character and the other degenerative. Epidemiologic findings provide convincing evidence that inflammatory disease, or periodontitis, is far more prevalent than degenerative disease in the United States and in many other countries as well.

Histopathologically, periodontitis is thought of as an extension of gingival inflammation which both begins and spreads in response to one or more of several local irritants. Degenerative disease, on the other hand, is thought of as a regressive process generally understood to stem from noninflammatory disturbances in cellular metabolism. It is not always easy to distinguish between the clinical effects of local and systemic factors in periodontal disease, but when, by process of elimination, local irritants are not entirely at fault, more subtle etiologic factors must also be looked for.

FINDINGS OF OTHER STUDIES

Systemic Conditions

Diabetes.—It stands to reason that ailments or conditions that generally weaken the body's resistance to infection will thereby increase the incidence and severity of periodontal disease. Furthermore, it is not inconceivable that periodontal disease may occasionally be due chiefly to an underlying systemic condition.

Numerous studies have attempted to establish whether there is a relationship between periodontal disease and diabetes. It has been reported that the prevalence and severity of periodontal disease are significantly greater among people with diabetes than among those without.[3-5] Alveolar bone loss has also been found to be more pronounced among people with diabetes,[6,7] and at least one study provides evidence that the degree of alveolar bone loss varies directly with increasing severity of the diabetic condition.[8] On the other hand, other studies (although relatively few) failed to find an association between periodontal disease and diabetes or alveolar bone loss and diabetes.[9,10]

In the balance, studies encourage more than they discourage a conclusion that periodontal disease and diabetes mellitus tend to occur together. As a result, it is widely believed that diabetic men and women run a higher than average risk of developing destructive periodontal disease. Findings from histopathologic studies, although comparatively scarce and in some instances limited to disquietingly few observations, further suggest that this conclusion may be well-founded. One investigator noted that blood vessels supplying the periodontium of teeth involved with periodontal disease were more constricted than expected.[11] Degenerative changes affecting the mandibular artery as well as arterioles of the periodontium have been reported.[12] Finally, it is known that degenerative changes which occur so often in the arterial system with aging are hastened by diabetes and, moreover, that the blood vessels of gingival tissues are among those that can be affected.[13,14] Thus, findings of the studies suggest that degenerative change within the periodontium of diabetic men and women could be intensified, if not actually caused, by a decrease in the blood flow attributable to the diabetic condition. This mechanism, if it does indeed operate, is consistent with the finding that some, but not all, people with diabetes are unusually susceptible to destructive periodontal disease. Briefly, vascular changes associated with diabetes mellitus hardly occur instantaneously. They undoubtedly occur gradually at rates which are likely to vary not only with the severity of the diabetic condition but also with the length of time the condition remains undetected and untreated or uncontrolled.

Because there are a great many variables associated with both diabetes and periodontal disease, it is not easy to investigate the relationship of individual variables associated with one condition and those associated with the other. Yet, even if they have not controlled for every unwanted factor, several studies have narrowed their investigations to relationships existing between more or less specific aspects of the two conditions. Some findings are consistent with an assumption that vascular changes are a decisive factor in periodontal disease but others seemingly are not. Among the former is a recent finding that periodontal status did not differ significantly between people with controlled diabetes and their nondiabetic relatives.[10] Another study found significant differences between diabetic and nondiabetic groups when calculus, age, and frequency of brushing were held constant.[6] However, an inverse relationship was found in the same study between the severity of periodontal disease and the severity of the diabetic condition when the latter severity was measured by whether or not the disease was controlled and, if uncontrolled, by the amount of insulin being taken. Since younger men generally had less severe periodontal disease but a more severe diabetic condition, it was concluded that age was a more important factor than the degree of diabetes in the severity of periodontal disease. Duration of the diabetic condition, however, was not taken into account nor was the past course of the disease. In another study, duration of known diabetes and the presence of diabetic complications, including retinopathy, were significantly associated with the prevalence and severity of periodontal disease.[3]

Glucose tolerance.—Studies have also considered the possibility that the prevalence and severity of periodontal disease vary by levels of

glucose tolerance. Results are difficult to interpret broadly because the very diversity of the groups selected for investigation and their highly selective characteristics suggest that some conflict in findings might well be due to sampling variability. Among studies finding no association of periodontal disease with carbohydrate metabolism, as evaluated by glucose tolerance tests, is one conducted on young, healthy males in military service, one conducted on a group of 20 patients with gingival or periodontal breakdown, and another conducted on a subsample of a probability sample of the adult population of a small community.[15-17] On the other hand, among a group of 100 routine dental patients, radiographic evidence of periodontal disease was found more often in those with a high glucose level 2 hours after challenge (100 mg. or more per 100 ml.) than in those with a lower level (80-89 per 100 ml.).[18] Results of glucose tolerance tests administered to subjects with chronic periodontal disease and to a control group with no periodontal disease showed that although fasting blood sugars of test subjects were not abnormal, their levels generally rose higher and generally returned more slowly to normal than did those of the controls.[19] As a last example, a study of patients with diabetes and others without found the prevalence and severity of periodontal disease differing significantly with both the variation of blood sugar levels and the duration of known diabetes.[3] However, an apparent rise in the prevalence and severity of periodontal disease with increasing levels of blood sugar was not statistically significant. In the study blood sugar levels of people with diabetes who took insulin were determined after a period of fasting, and those of other diabetic patients were determined 2 hours after eating.

Cardiovascular disease.—If vascular changes contribute to the incidence and severity of periodontal disease, an association of periodontal disease with chronic cardiovascular disease might be expected. Gingival biopsies from men with arteriosclerosis and from those without arteriosclerosis but with various nondebilitating illnesses revealed that the arterioles of the former group had thicker walls and narrower lumens.[20] Another study reported that alveolar bone loss was more pronounced in patients suffering from cardiovascular disease, endocrine dysfunctions, and malignant tumors than in patients hospitalized for various other ailments.[21] As a final example, and one which illustrates the complexity of an investigation designed to single out various factors associated with periodontal disease and systemic conditions, a study of the interaction of diabetes, arteriosclerosis, calculus, and alveolar resorption is noteworthy.[9] It was conducted on experimental groups consisting of people with diabetes, diabetic suspects, and arteriosclerotic people without diabetes who, it is important to note, were screened from a larger group whose demographic characteristics were hardly typical of the U.S. population. A control group was made up of people free from both diabetes and arteriosclerosis, each of whom was selected to match an experimental subject by age, sex, race, and absence of other metabolic diseases. It was determined that the groups did not differ significantly in frequency of toothbrushing and dental prophylaxis nor in amount of smoking. Findings of the study showed that neither diabetes mellitus nor arteriosclerosis was significantly associated with alveolar bone loss although the group with arteriosclerosis did have more alveolar resorption than their controls. No relationship between diabetes and calculus formation was found, but positive relationships between calculus and alveolar bone loss and between diabetes and arteriosclerosis were demonstrated. Thus the conclusions of this study do not agree with an assumption that either diabetes or arteriosclerosis is a significant factor in causing or aggravating periodontal disease.

Psychological Symptoms

Several studies have associated periodontal status not only with certain psychiatric symptoms but also with various emotional factors.[22-28] Two of the studies, moreover, found that the severity of periodontal conditions increases with evidence of deepening anxiety. Interestingly, it has been speculated that this increased severity may be attributable to vascular changes resulting from release into the blood stream of excessive amounts of endocrinal products, including ACTH, STH, corticoids, and adrenalin.

Summary

Most studies reviewed above were designed explicitly to gather data indicating whether or not an absolute relationship exists between periodontal disease and various systemic conditions. The present report bears on the same question by seeking to measure the relative effect that such relationships might have on the occurrence of periodontal disease in the U.S. white adult population at large. If the prevalence and severity of periodontal disease are found to mount with rising levels of, for instance, blood pressure, it would be safe to conclude that the two conditions are associated in one way or another. On the other hand, the absence of a trend cannot be interpreted to mean necessarily that there is no association between the conditions. Although composed of nearly 6,700 men and women (a relatively large number for most surveys), the Health Examination Survey (HES) sample is barely large enough for some analytic purposes and simply inadequate for others. When comparing estimates of periodontal disease for several groups composed of people whose sex and race are the same but whose level of blood pressure is different, the sampling variability associated with the estimates becomes quite large. It should also be realized that a relationship between periodontal disease and blood pressure will more likely be reflected in survey estimates if the relationship is strong rather than weak and if it coincides generally with rising levels of both conditions rather than with a narrow, critical range of either one condition or the other.

The difference in the analytic approach between this survey and most others stems largely from the design and statistical property of their samples. Studies are usually conducted on samples of people who are selected because they have a particular illness and who are, moreover, accessible for investigation. When samples are not chosen randomly from large populations but selectively from small ones, inferences drawn from sample data to a large population are statistically unwarranted. For example, few people would be surprised to find that patients with diabetes in one hospital differ in many ways from people with diabetes who are not hospitalized and also from patients hospitalized elsewhere for the same condition.

Estimates of periodontal disease and other conditions presented in this report are based on findings obtained during 1960-62 from examinations conducted on 5,719 men and women 18-79 years of age (appendix II). By virtue of the statistical principles determining their selection, the examined people were a probability sample of the vast population to which they belonged—approximately 97.5 million adults composing the civilian, noninstitutional white population of the United States. Selection of the sample, the content of the examination, an assessment of the dental examination, and the procedure for deriving national estimates are described in previous reports.[29,30]

FINDINGS OF THE HEALTH EXAMINATION SURVEY

Introduction

In the discussions that follow, the population is classified in a variety of ways, and the mean Periodontal Indexes of different groups are compared. If the population is classified by blood pressure, for example, the mean Periodontal Index (PI) is examined to determine whether it varies from one level of blood pressure to another. In making a comparison, allowances must be made for the distribution of people by age and sex. Because the sampling variability of age-sex-specific values for any group is usually large, a summary comparison by sex was preferable to a presentation of mean periodontal scores specific by age and sex. For this reason the actual score for each group is compared with an expected score.

The expected score of a particular group was obtained by weighting age- and sex-specific scores for the U.S. population by the age-specific distribution for that group. The obvious meaning can be attached to differences between actual and expected scores with the understanding that differences may occasionally arise by chance. A positive difference, for example, indicates that the score for a group is higher than expected. Alternatively, the data can be presented as a ratio of actual to expected scores. If the ratio is greater than 1.0, the actual score is higher than expected. If the ratio is less than 1.0, the actual score is lower than expected. In addition to a summary

comparison by sex, a similar summary for the total population was calculated.

Substantial differences by race have been found in the prevalence of destructive periodontal disease.[1] Since differences by race are present for some of the conditions considered, e.g., hypertension,[31] it was decided to simplify analysis of the data by including only white men and women. As a further restriction, the population analyzed includes only people who had at least one natural tooth and who were therefore susceptible to destructive periodontal disease.

Blood pressure.—Both men and women hypertensives had elevated periodontal scores. This elevation was statistically significant for women (table 1 and fig. 1). A trend of rising periodontal scores with increasing pressure was present for both systolic and diastolic blood pressure for both sexes (table 2; figs. 2 and 3).

People with higher blood pressure tended to have poorer oral hygiene than those with lower blood pressure (appendix III).

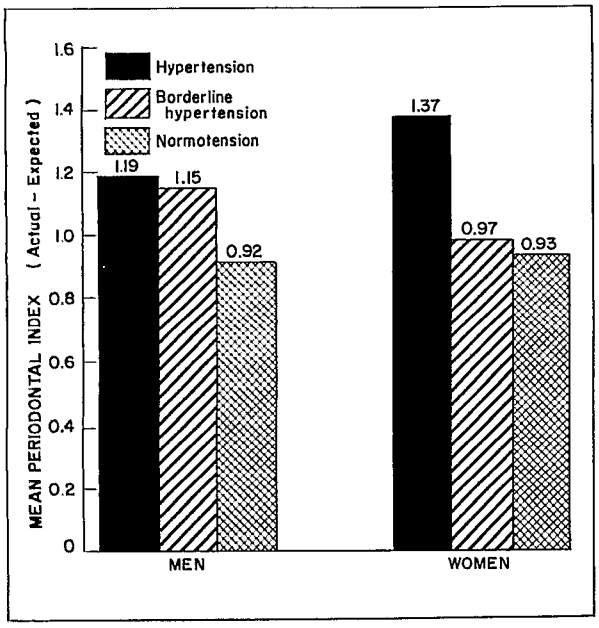

Figure 1. Ratio of actual to expected mean Periodontal Index for white adults, by sex and the presence or absence of hypertension.

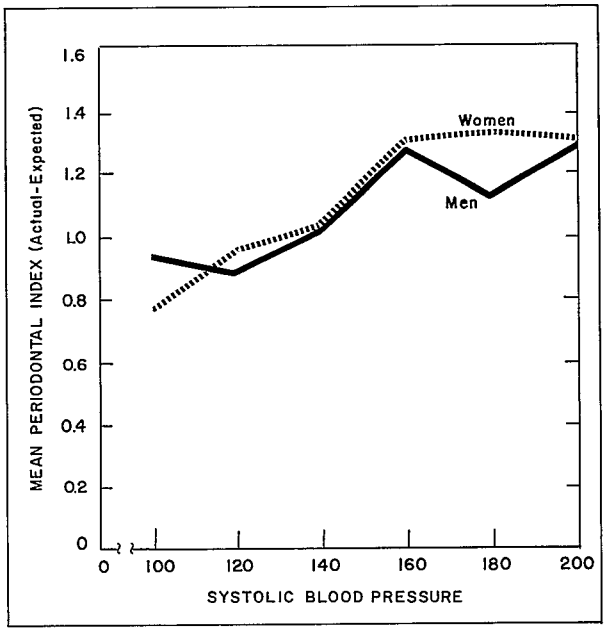

Figure 2. Ratio of actual to expected mean Periodontal Index for white adults, by systolic blood pressure and sex.

Peripheral vascular disease.—Palpation of peripheral pulses has long been used for the diagnosis of peripheral vascular disease. Although its accuracy in the hands of the average clinician leaves something to be desired, it nonetheless serves as a means of identifying those individuals with some degree of peripheral arterial disease. Persons with nonpalpable pulses (posterior tibial) were considered to be in the diseased category. Pulses in both right and left legs were palpated.

For the right leg, periodontal scores were elevated for both men and women, and they were significantly elevated for men. A similar situation holds for the left leg (table 3 and fig. 4).

Ocular fundus.—The ocular fundus was visualized by means of an ophthalmoscope and the condition of the retinal vessels was rated. Right and left eyes were considered separately.

For both men and women, an increased light reflex for both eyes was associated with a statistically significant elevation of mean periodontal scores (table 4 and fig. 5). Persons with other vas-

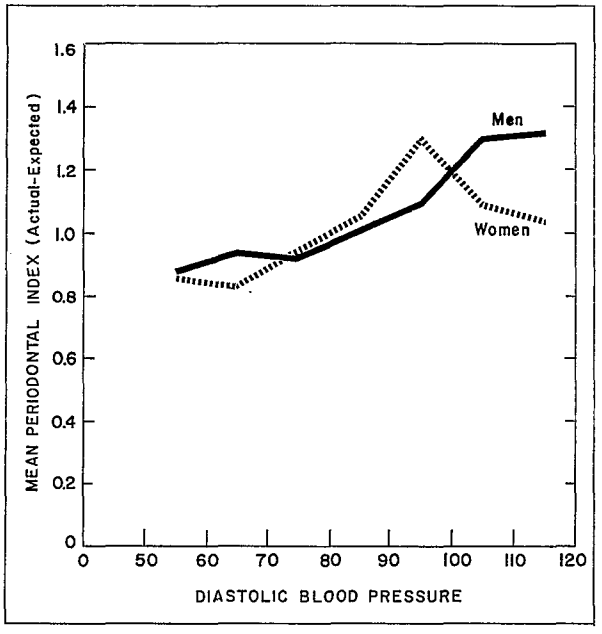

Figure 3. Ratio of actual to expected mean Periodontal Index for white adults, by diastolic blood pressure and sex.

cular findings, narrow arterioles, tortuous arterioles, and arteriovenous (AV) compression had elevated periodontal scores, but none of the elevations were significant (tables 4 and 5). As the Keith-Wagener (K-W) grade increased, there was a trend toward higher periodontal scores (table 6).

Heart disease.—Tables 7 and 8 show a nonsignificant increase in periodontal scores for adults with definite coronary heart disease and hypertensive heart disease. Table 9 presents findings for a variety of ECG abnormalities. Although none of the findings are statistically significant, there is a general pattern of elevation of periodontal scores for people with ECG abnormalities.

Urinary albumin.—Albumin in the urine (a determination made only for men) is a strong indication of the presence of kidney disease. A significant rise in periodontal scores was associated with the finding of a trace of albumin, and a nonsignificant rise with a positive finding of albumin in the urine. It should be noted, however, that the actual number of people with albumin present in the urine was quite small (table 10).

Serum cholesterol.—No relationship between periodontal scores and serum cholesterol was found for either men or women (table 11).

Glucose tolerance and diabetes.—There was an elevation in periodontal scores for men at blood glucose levels above 208 mg.%. The elevation was not quite significant, however. A similar nonsignificant elevation was found in periodontal scores for men with diagnosed diabetes. (Note.—Individuals with previously diagnosed diabetes did not take the 1-hour glucose tolerance test.) Women with glucose levels above 208 mg.% or with diagnosed diabetes did not have elevated periodontal scores (tables 12 and 13; fig. 6). Men and women with glycosuria had nonsignificant elevations of periodontal scores (table 14).

Nervous symptoms.—The self-administered questionnaire used in the examination contained

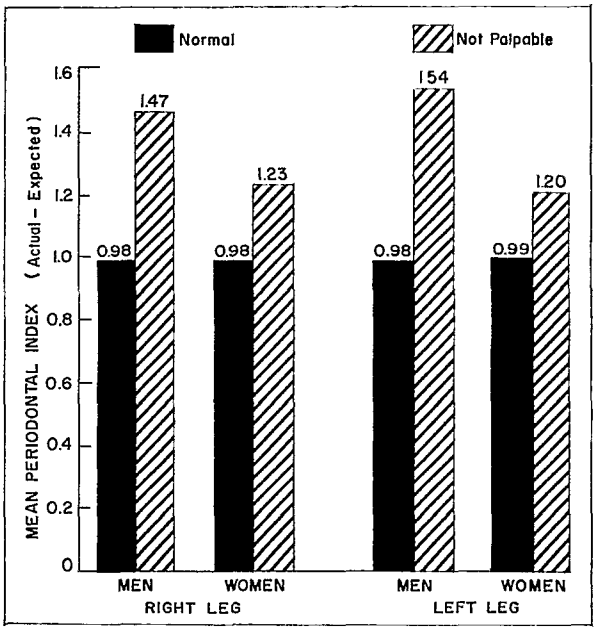

Figure 4. Ratio of actual to expected mean Periodontal Index for white adults, by quality of right and left posterior tibial pulse and sex.

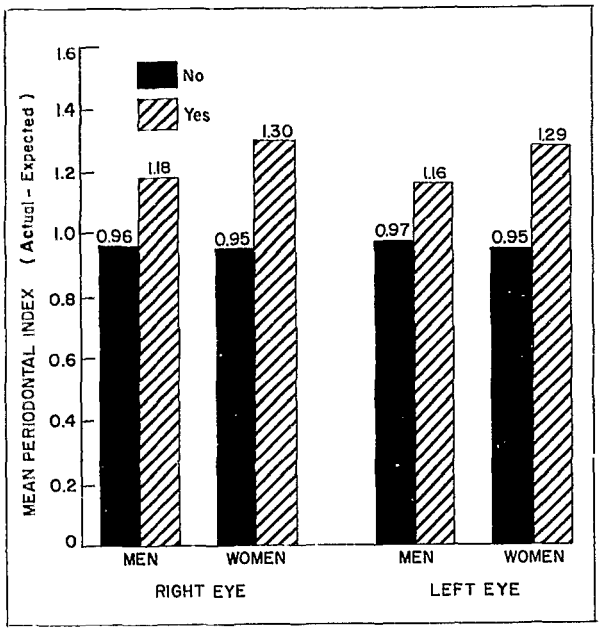

Figure 5. Ratio of actual to expected mean Periodontal Index for white adults, by ocular fundi findings (increased light reflex) and sex

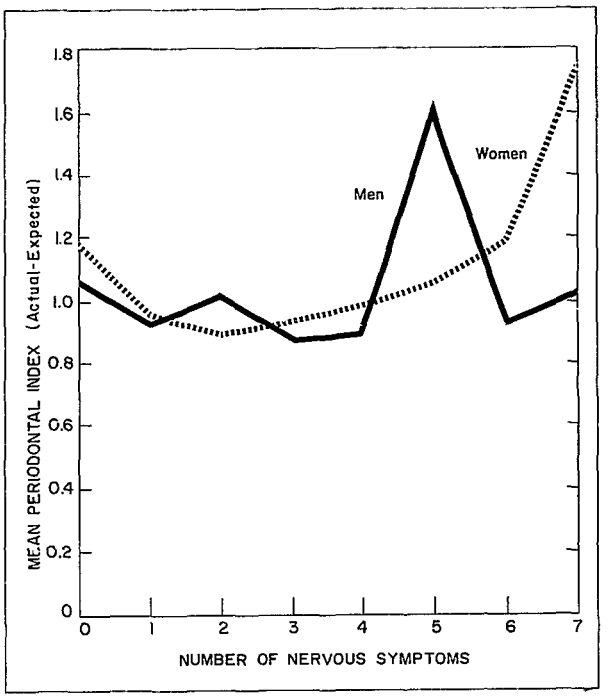

Figure 7. Ratio of actual to expected mean Periodontal Index for white adults, by sex and nervous symptom score.

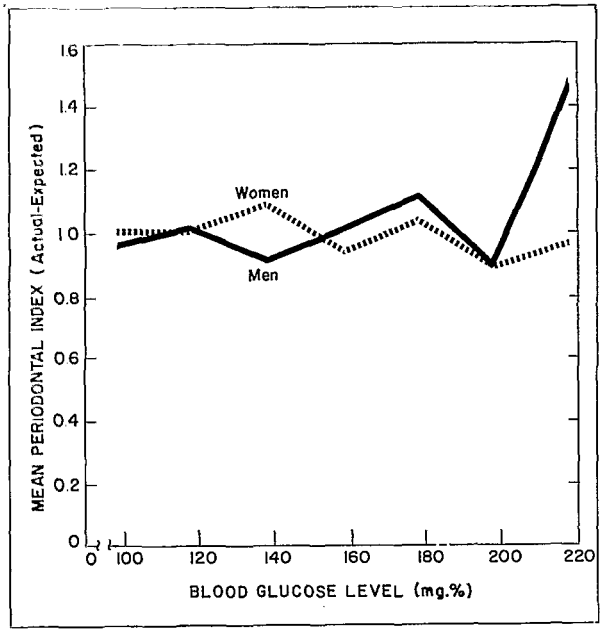

Figure 6. Ratio of actual to expected mean Periodontal Index for white adults, by blood glucose levels and sex.

items concerned with psychological symptoms. Questions were asked, such as: "Do your hands ever tremble enough to bother you? Yes? No?" (appendix I). The items included the experience of a past emotional crisis or "nervous breakdown," general feeling of nervousness or tension, sleep difficulties, nightmares, anxiety manifested in trembling or excessively perspiring hands, and psychological inertia or immobilization. A scoring system of 0-7 was devised. Each symptom was given a point value of one, with the exception that only one point was given for having both a positive history of a nervous breakdown and feelings of an impending nervous breakdown.

There was a nonsignificant elevation in periodontal scores for both men and women who answered yes to having had a history of a nervous breakdown. For women there was a trend toward higher periodontal scores with increasing numbers of nervous symptoms. This trend was not present for men (tables 15 and 16; fig. 7).

DISCUSSION AND CONCLUSIONS

Although the subject of an extensive literature, the relationship between periodontal disease and systemic conditions is still a matter of controversy. It is almost always easy, of course, to point out weaknesses or flaws in the design and conduct of most studies. In some, questionable control groups, inadequate numbers of subjects, and insufficient data on the conditions being studied are open to criticism. In others, the choice of study groups selected from a specific clinic, hospital, or institution and composed of a particular age, sex, or race leaves much to be desired if inferences are to be drawn from the findings to a large population.

Data presented in this report show a relationship between periodontal disease and three systemic conditions. The conditions can be loosely classified as those affecting the cardiovascular system, as psychological states, and as diabetes mellitus. Considered as a whole, HES findings lend support to the hypothesis that periodontal disease is associated with vascular pathology. The positive, linear relationship of increasing periodontal disease with rising blood pressure is of particular interest. This association of periodontal disease with vascular pathology also appears to warrant further study of the relationship of periodontal disease with kidney disease (which is closely related to vascular pathology).

Since the number of sample men and women with diabetes was small, the present data are unable to indicate whether there is a relationship between periodontal disease and diabetes. HES data also failed to show a significant increase in periodontal disease associated with rising levels of blood glucose. The data suggest, however, that there may be a rise in periodontal disease among men, but not among women, whose blood glucose level is more than 208 mg.%.

An interesting phenomenon found by the survey is a trend toward higher periodontal scores in women, but not in men, with an increasing number of nervous symptoms. Women have appreciably cleaner teeth than men,[2] probably due to more frequent toothbrushing. It is possible that increasing nervous symptoms might tend to decrease the frequency of toothbrushing and thus lead to higher periodontal scores. Unfortunately, no history of the frequency of toothbrushing was obtained by the Health Examination Survey.

SUMMARY

Despite the lack of knowledge about the pathogenesis of degenerative periodontal disease, it seems not only possible but indeed likely that any ailment or condition that lowers the body's resistance to infection will favor or perhaps even cause the onset and progression of destructive periodontal disease. Several studies found that people with diabetes mellitus are more susceptible to periodontal disease than people without diabetes. Cardiovascular disease and other chronic ailments have also been associated with a rising prevalence and severity of periodontal disease. In addition a number of other studies discovered an association between periodontal disease and certain psychiatric symptoms and emotional factors.

Estimates of the prevalence and severity of periodontal disease, as measured by the Periodontal Index (PI), are presented for U.S. white adults 18-79 years of age. Both actual and expected (age-adjusted) estimates for men and women, arrayed by selected examination findings, are included. All estimates are based on standardized examinations conducted during 1960-62 on a probability sample of the U.S. adult population at large. Estimates in this report, however, include only those white men and women (approximately 78 million) who had at least one natural tooth.

Many estimates that are presented point to the conclusion that periodontal disease and cardiovascular changes are associated.

Pertinent findings can be described as follows:

1. Women with hypertension have a statistically significant elevation of their periodontal scores, and hypertensive men have a near-significant elevation.

2. Periodontal scores of men and women rise with increasing systolic and diastolic blood pressure.

3. People whose peripheral pulse could not be palpated have more periodontal disease than those with palpable pulses. The elevation in periodontal scores of men was statistically significant.

4. Men and women with increased light reflex have higher than expected periodontal scores. The elevation of scores associated with increased light reflex is statistically significant.

5. People with definite coronary heart disease or with hypertensive heart disease have relatively high periodontal scores.

6. People with abnormal ECG tracings generally tend to have higher periodontal scores than those with normal tracings.

Other findings of the Health Examination Survey include the following:

1. Men who were diabetic and men whose blood glucose level exceeded 208 mg.% tend to have relatively high periodontal scores.

2. Men and women with glycosuria tend to have elevated periodontal scores.

3. A trend toward higher periodontal scores among women is associated with an increasing number of nervous symptoms.

4. A statistically significant rise in periodontal scores among men is associated with traces of albumin in the urine.

Most of the foregoing findings are not statistically significant. All together, however, they form a pattern whose consistency cannot be ignored. Thus, it must be said that national estimates, based on a probability sample of the U.S. population of white adults, support a conclusion that the prevalence and severity of periodontal disease are associated with various systemic findings, especially those indicative of chronic vascular disease.

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DETAILED TABLES

Table 1. Actual and expected mean Periodontal Index for white adults, by sex and the presence or absence of hypertension: United States, 1960-62

Sex and presence or absence of hypertension	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Hypertension	499	1.86	1.47	0.39	1.27	0.27
Borderline hypertension	584	1.43	1.32	0.11	1.08	0.23
Normotension	3,523	0.88	0.95	-0.07	0.93	0.08
Men						
Hypertension	225	2.03	1.71	0.32	1.19	0.36
Borderline hypertension	334	1.66	1.44	0.22	1.15	0.34
Normotension	1,596	1.08	1.18	-0.10	0.92	0.11
Women						
Hypertension	244	1.68	1.23	0.45	1.37	0.26
Borderline hypertension	250	1.12	1.16	-0.04	0.97	0.18
Normotension	1,927	0.70	0.75	-0.05	0.93	0.05

[1] SE = standard error.

Table 2. Actual and expected mean Periodontal Index for white adults, by systolic and diastolic blood pressures and sex: United States, 1960-62

Blood pressure and sex	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
SYSTOLIC BLOOD PRESSURE						
Both sexes						
Less than 90	12	0.18	0.53	-0.35	0.34	0.11
90-109	756	0.63	0.75	-0.12	0.84	0.11
110-129	2,156	0.87	0.94	-0.07	0.93	0.07
130-149	1,140	1.23	1.22	0.01	1.01	0.19
150-169	358	1.90	1.48	0.42	1.28	0.27
170-189	116	2.03	1.68	0.35	1.21	0.46
190-209	54	2.33	1.80	0.53	1.29	0.69
210-229	9	*	*	*	*	*
230 and over	6	*	*	*	*	*
Men						
Less than 90	1	0.20	0.58	-0.38	0.34	0.28
90-109	219	0.99	1.05	-0.06	0.94	0.24
110-129	1,029	1.02	1.14	-0.12	0.89	0.11
130-149	651	1.35	1.34	0.01	1.01	0.25
150-169	202	2.14	1.67	0.47	1.28	0.28
170-189	50	2.30	2.06	0.24	1.12	0.74
190-209	26	2.87	2.22	0.65	1.29	1.10
210-229	4	*	*	*	*	*
230 and over	3	*	*	*	*	*
Women						
Less than 90	11	0.17	0.53	-0.36	0.32	0.14
90-109	537	0.48	0.62	-0.14	0.77	0.08
110-129	1,127	0.72	0.75	-0.03	0.96	0.05
130-149	489	1.06	1.04	0.02	1.02	0.21
150-169	156	1.58	1.22	0.36	1.30	0.35
170-189	66	1.81	1.38	0.43	1.31	0.52
190-209	28	1.85	1.42	0.43	1.30	0.91
210-229	5	*	*	*	*	*
230 and over	3	*	*	*	*	*
DIASTOLIC BLOOD PRESSURE						
Both sexes						
Less than 50	48	0.89	0.71	0.18	1.25	0.31
50-59	178	0.67	0.76	-0.09	0.88	0.13
60-69	870	0.77	0.86	-0.09	0.90	0.12
70-79	1,672	0.95	1.02	-0.07	0.93	0.10
80-89	1,175	1.19	1.16	0.03	1.03	0.13
90-99	462	1.52	1.30	0.22	1.17	0.31
100-109	141	1.74	1.42	0.32	1.23	0.34
110-119	41	1.92	1.55	0.37	1.24	0.68
120 and over	20	1.54	1.48	0.06	1.04	1.20
Men						
Less than 50	29	0.99	0.79	0.20	1.25	0.43
50-59	60	0.93	1.06	-0.13	0.88	0.25
60-69	349	1.03	1.09	-0.06	0.94	0.16
70-79	791	1.15	1.23	-0.08	0.93	0.15
80-89	608	1.38	1.37	0.01	1.01	0.20
90-99	239	1.61	1.47	0.14	1.10	0.44
100-109	76	2.16	1.65	0.51	1.31	0.44
110-119	23	2.43	1.84	0.59	1.32	1.12
120 and over	10	0.91	1.59	-0.68	0.57	0.89
Women						
Less than 50	19	0.72	0.56	0.16	1.29	0.49
50-59	118	0.52	0.60	-0.08	0.87	0.14
60-69	521	0.59	0.71	-0.12	0.83	0.13
70-79	881	0.77	0.82	-0.05	0.94	0.07
80-89	567	0.98	0.93	0.05	1.05	0.14
90-99	223	1.43	1.09	0.34	1.31	0.27
100-109	65	1.27	1.16	0.11	1.09	0.50
110-119	18	1.18	1.13	0.05	1.04	0.73
120 and over	10	2.07	1.39	0.68	1.49	2.53

[1] SE = standard error.

Table 3. Actual and expected mean Periodontal Index for white adults, by quality of right and left posterior tibial pulse and sex: United States, 1960-62

Quality of posterior tibial pulse and sex	Number of persons	Mean Periodontal Index			Actual / expected	2 × SE[1]
		Actual	Expected	Difference		
RIGHT LEG						
Both sexes						
Normal	4,131	0.99	1.02	-0.03	0.97	0.09
Bounding	26	2.04	1.64	0.40	1.24	1.48
Diminished	227	1.52	1.50	0.02	1.01	0.31
Not palpable	197	1.73	1.31	0.42	1.32	0.44
Men						
Normal	2,009	1.20	1.23	-0.03	0.98	0.15
Bounding	21	2.30	1.75	0.55	1.31	1.51
Diminished	85	2.01	1.98	0.03	1.02	0.54
Not palpable	60	2.64	1.80	0.84	1.47	0.81
Women						
Normal	2,122	0.78	0.80	-0.02	0.98	0.06
Bounding	5	*	*	*	*	*
Diminished	142	1.25	1.24	0.01	1.01	0.26
Not palpable	137	1.34	1.09	0.25	1.23	0.34
LEFT LEG						
Both sexes						
Normal	4,105	0.99	1.01	-0.02	0.98	0.10
Bounding	27	20.4	1.73	0.31	1.18	1.13
Diminished	228	1.46	1.48	-0.02	0.99	0.28
Not palpable	223	1.73	1.31	0.42	1.32	0.39
Men						
Normal	2,001	1.20	1.23	-0.03	0.98	0.15
Bounding	22	2.27	1.81	0.46	1.25	1.33
Diminished	86	1.88	1.92	-0.04	0.98	0.51
Not palpable	65	2.72	1.77	0.95	1.54	0.67
Women						
Normal	2,104	0.78	0.79	-0.01	0.99	0.07
Bounding	5	*	*	*	*	*
Diminished	142	1.22	1.22	0.00	1.00	0.25
Not palpable	158	1.34	1.12	0.22	1.20	0.31

[1] SE = standard error.

Table 4. Actual and expected mean Periodontal Index for white adults, by ocular fundi findings (increased light reflex and narrow arterioles) and sex: United States, 1960-62

Ocular fundi findings and sex	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
INCREASED LIGHT REFLEX—RIGHT EYE						
Both sexes						
Yes	439	1.93	1.58	0.35	1.22	0.27
No	4,168	0.96	1.00	-0.04	0.96	0.08
Men						
Yes	247	2.15	1.82	0.33	1.18	0.28
No	1,938	1.16	1.21	-0.05	0.96	0.13
Women						
Yes	192	1.64	1.26	0.38	1.30	0.34
No	2,230	0.77	0.81	-0.04	0.95	0.06
INCREASED LIGHT REFLEX—LEFT EYE						
Both sexes						
Yes	436	1.90	1.58	0.32	1.20	0.25
No	4,171	0.96	1.00	-0.04	0.96	0.09
Men						
Yes	244	2.11	1.82	0.29	1.16	0.28
No	1,941	1.17	1.21	-0.04	0.97	0.14
Women						
Yes	192	1.63	1.26	0.37	1.29	0.33
No	2,230	0.77	0.81	-0.04	0.95	0.06
NARROW ARTERIOLES—RIGHT EYE						
Both sexes						
Yes	620	1.68	1.58	0.10	1.06	0.29
No	3,987	0.95	0.97	-0.02	0.98	0.09
Men						
Yes	329	1.93	1.85	0.08	1.04	0.30
No	1,856	1.16	1.17	-0.01	0.99	0.14
Women						
Yes	291	1.40	1.27	0.13	1.10	0.32
No	2,131	0.76	0.78	-0.02	0.97	0.06
NARROW ARTERIOLES—LEFT EYE						
Both sexes						
Yes	613	1.64	1.57	0.07	1.04	0.26
No	3,994	0.96	0.97	-0.01	0.99	0.09
Men						
Yes	323	1.88	1.84	0.04	1.02	0.26
No	1,862	1.17	1.18	-0.01	0.99	0.14
Women						
Yes	290	1.37	1.26	0.11	1.09	0.31
No	2,132	0.77	0.78	-0.01	0.99	0.06

[1] SE = standard error.

Table 5. Actual and expected mean Periodontal Index for white adults, by ocular fundi findings (tortuous arterioles and AV compression) and sex: United States, 1960-62

Ocular fundi findings and sex	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
TORTUOUS ARTERIOLES—RIGHT EYE						
Both sexes						
Yes	360	1.83	1.53	0.30	1.20	0.33
No	4,247	0.99	1.02	-0.03	0.97	0.09
Men						
Yes	192	2.12	1.78	0.34	1.19	0.35
No	1,993	1.20	1.24	-0.04	0.97	0.13
Women						
Yes	168	1.52	1.26	0.26	1.21	0.34
No	2,254	0.79	0.81	-0.02	0.98	0.07
TORTUOUS ARTERIOLES—LEFT EYE						
Both sexes						
Yes	358	1.80	1.53	0.27	1.18	0.30
No	4,249	0.99	1.02	-0.03	0.97	0.09
Men						
Yes	191	2.04	1.78	0.26	1.15	0.35
No	1,994	1.21	1.24	-0.03	0.98	0.14
Women						
Yes	167	1.55	1.26	0.29	1.23	0.32
No	2,255	0.79	0.81	-0.02	0.98	0.07
AV COMPRESSION—RIGHT EYE						
Both sexes						
Yes	231	1.75	1.59	0.16	1.10	0.43
No	4,376	1.02	1.03	-0.01	0.99	0.10
Men						
Yes	124	2.12	1.84	0.28	1.15	0.62
No	2,061	1.23	1.25	-0.02	0.98	0.15
Women						
Yes	107	1.38	1.33	0.05	1.04	0.27
No	2,315	0.82	0.82	0.00	1.00	0.07
AV COMPRESSION—LEFT EYE						
Both sexes						
Yes	228	1.75	1.59	0.16	1.10	0.41
No	4,379	1.02	1.03	-0.01	0.99	0.10
Men						
Yes	121	2.07	1.85	0.22	1.12	0.62
No	2,064	1.24	1.25	-0.01	0.99	0.15
Women						
Yes	107	1.43	1.33	0.10	1.08	0.32
No	2,315	0.81	0.82	-0.01	0.99	0.07

[1] SE = standard error.

Table 6. Actual and expected mean Periodontal Index for white adults, by sex and K-W grade: United States, 1960-62

Sex and K-W grade	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
0	3,644	0.87	0.92	-0.05	0.95	0.09
1	612	1.63	1.50	0.13	1.09	0.29
2	195	1.72	1.67	0.05	1.03	0.41
3	11	2.69	1.54	1.15	1.75	2.67
4	2	*	*	*	*	*
Other	143	1.91	1.52	0.39	1.26	0.46
Men						
0	1,670	1.06	1.11	-0.05	0.95	0.13
1	325	1.80	1.72	0.08	1.05	0.35
2	104	2.16	1.98	0.18	1.09	0.57
3	8	*	*	*	*	*
4	2	*	*	*	*	*
Other	76	2.03	1.72	0.31	1.18	0.68
Women						
0	1,974	0.70	0.74	-0.04	0.95	0.06
1	287	1.43	1.22	0.21	1.17	0.31
2	91	1.23	1.31	-0.08	0.94	0.42
3	3	*	*	*	*	*
4	-	-	-	-	-	-
Other	67	1.76	1.29	0.47	1.36	0.41

[1]SE = standard error.

Table 7. Actual and expected mean Periodontal Index for white adults, by sex and coronary heart disease: United States, 1960-62

Sex and coronary heart disease	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Definite	86	2.01	1.81	0.20	1.11	0.53
Suspect	62	1.21	1.58	-0.37	0.77	0.35
No coronary heart disease	4,459	1.04	1.03	0.01	1.01	0.10
Men						
Definite	58	2.24	2.02	0.22	1.11	0.65
Suspect	31	1.44	1.83	-0.39	0.79	0.61
No coronary heart disease	2,096	1.25	1.25	0.00	1.00	0.14
Women						
Definite	28	1.56	1.39	0.17	1.12	0.69
Suspect	31	0.99	1.34	-0.35	0.74	0.60
No coronary heart disease	2,363	0.83	0.83	0.00	1.00	0.07

[1]SE = standard error.

Table 8. Actual and expected mean Periodontal Index for white adults, by sex and hypertensive heart disease: United States, 1960-62

Sex and hypertensive heart disease	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Definite	253	1.79	1.58	0.21	1.13	0.48
Suspect	133	1.63	1.51	0.12	1.08	0.44
No heart disease	4,221	0.99	1.01	-0.02	0.98	0.09
Men						
Definite	118	1.97	1.88	0.09	1.05	0.62
Suspect	81	2.05	1.70	0.35	1.21	0.57
No heart disease	1,986	1.21	1.23	-0.02	0.98	0.13
Women						
Definite	135	1.64	1.34	0.30	1.22	0.50
Suspect	52	0.98	1.23	-0.25	0.80	0.33
No heart disease	2,235	0.79	0.80	-0.01	0.99	0.06

[1]SE = standard error.

Table 9. Actual and expected mean Periodontal Index for white adults, by ECG findings and sex: United States, 1960-62

ECG findings and sex	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
AXIS DEVIATION						
Both sexes						
Left axis deviation	96	1.74	1.53	0.21	1.14	0.51
No axis deviation	818	1.41	1.31	0.10	1.08	0.22
Normal ECG	3,676	0.95	0.98	-0.03	0.97	0.08
Men						
Left axis deviation	56	1.76	1.68	0.08	1.05	0.57
No axis deviation	494	1.55	1.46	0.09	1.06	0.24
Normal ECG	1,629	1.18	1.21	-0.03	0.98	0.15
Women						
Left axis deviation	40	1.72	1.31	0.41	1.31	1.05
No axis deviation	324	1.18	1.07	0.11	1.10	0.24
Normal ECG	2,047	0.77	0.80	-0.03	0.96	0.05
VENTRICULAR HYPERTROPHY						
Both sexes						
Left ventricular hypertrophy	207	1.29	1.18	0.11	1.09	0.25
No ventricular hypertrophy	702	1.49	1.38	0.11	1.08	0.22
Normal ECG	3,676	0.95	0.98	-0.03	0.97	0.08
Men						
Left ventricular hypertrophy	169	1.26	1.21	0.05	1.04	0.21
No ventricular hypertrophy	379	1.70	1.59	0.11	1.07	0.26
Normal ECG	1,629	1.18	1.21	-0.03	0.98	0.15
Women						
Left ventricular hypertrophy	38	1.42	1.04	0.38	1.37	0.92
No ventricular hypertrophy	323	1.22	1.11	0.11	1.10	0.27
Normal ECG	2,047	0.77	0.80	-0.03	0.96	0.05
T-WAVE ABNORMALITIES						
Both sexes						
Nonspecific T-wave abnormalities	47	1.47	1.37	0.10	1.07	0.64
Left ventricular ischemia	29	1.90	1.53	0.37	1.24	0.67
Nonspecific T-wave abnormalities, outside criteria	41	1.58	1.33	0.25	1.19	0.52
No abnormality of T-wave	793	1.42	1.32	0.10	1.08	0.20
Normal ECG	3,676	0.95	0.98	-0.03	0.97	0.08

See footnote at end of table.

Table 9. Actual and expected mean Periodontal Index for white adults, by ECG findings and sex: United States, 1960-62—Con.

ECG findings and sex	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
T-WAVE ABNORMALITIES—Con.						
Men						
Nonspecific T-wave abnormalities	24	1.84	1.58	0.26	1.16	1.26
Left ventricular ischemia	15	1.69	1.68	0.01	1.01	1.47
Nonspecific T-wave abnormalities, outside criteria	14	1.45	1.72	-0.27	0.84	0.79
No abnormality of T-wave	493	1.57	1.46	0.11	1.08	0.18
Normal ECG	1,629	1.18	1.21	-0.03	0.98	0.15
Women						
Nonspecific T-wave abnormalities	23	1.04	1.13	-0.09	0.92	0.58
Left ventricular ischemia	14	2.07	1.40	0.67	1.48	1.28
Nonspecific T-wave abnormalities, outside criteria	27	1.65	1.10	0.55	1.50	0.75
No abnormality of T-wave	300	1.18	1.08	0.10	1.09	0.34
Normal ECG	2,047	0.77	0.80	-0.03	0.96	0.05
ST ABNORMALITIES						
Both sexes						
Subendocardial ischemia with or without digitalis	23	2.92	2.08	0.84	1.40	1.34
Subendocardial ischemia with or without digitalis, outside criteria	22	1.49	1.35	0.14	1.10	0.87
No abnormality of ST segment or junction	857	1.40	1.31	0.09	1.07	0.19
Normal ECG	3,676	0.95	0.98	-0.03	0.97	0.80
Men						
Subendocardial ischemia with or without digitalis	13	3.15	2.48	0.67	1.27	1.67
Subendocardial ischemia with or without digitalis, outside criteria	9	*	*	*	*	*
No abnormality of ST segment or junction	523	1.53	1.45	0.08	1.06	0.21
Normal ECG	1,629	1.18	1.21	-0.03	0.98	0.15
Women						
Subendocardial ischemia with or without digitalis	10	2.65	1.63	1.02	1.63	1.68
Subendocardial ischemia with or without digitalis, outside criteria	13	1.29	1.13	0.16	1.14	0.80
No abnormality of ST segment or junction	334	1.19	1.08	0.11	1.10	0.28
Normal ECG	2,047	0.77	0.80	-0.03	0.96	0.05

[1]SE = standard error.

Table 10. Actual and expected mean Periodontal Index for white men, by urinary albumin: United States, 1960-62

Urinary albumin	Number of men	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Positive	16	1.77	1.38	0.39	1.28	0.79
Trace	17	3.08	1.76	1.32	1.75	1.05
Negative	2,094	1.26	1.27	-0.01	0.99	0.15

[1]SE = standard error.

Table 11. Actual and expected mean Periodontal Index for white adults, by sex and serum cholesterol value: United States, 1960-62

Sex and serum cholesterol value	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Less than 160	469	0.68	0.70	-0.02	0.97	0.10
160-179	580	0.73	0.81	-0.08	0.90	0.12
180-199	684	0.93	0.92	0.01	1.01	0.11
200-219	839	1.08	1.04	0.04	1.04	0.16
220-239	655	1.29	1.19	0.10	1.08	0.19
240-259	492	1.15	1.22	-0.07	0.94	0.16
260-279	325	1.19	1.27	-0.08	0.94	0.26
280 and over	448	1.34	1.31	0.03	1.02	0.20
Men						
Less than 160	220	0.81	0.87	-0.06	0.93	0.16
160-179	277	0.92	1.01	-0.09	0.91	0.15
180-199	308	1.31	1.22	0.09	1.07	0.22
200-219	405	1.27	1.28	-0.01	0.99	0.25
220-239	350	1.52	1.42	0.10	1.07	0.24
240-259	225	1.34	1.43	-0.09	0.94	0.26
260-279	162	1.36	1.42	-0.06	0.96	0.39
280 and over	194	1.60	1.54	0.06	1.04	0.37
Women						
Less than 160	249	0.57	0.54	0.03	1.06	0.12
160-179	303	0.56	0.63	-0.07	0.89	0.15
180-199	376	0.60	0.67	-0.07	0.90	0.14
200-219	434	0.90	0.80	0.10	1.12	0.12
220-239	305	1.00	0.91	0.09	1.10	0.20
240-259	267	0.98	1.05	-0.07	0.93	0.20
260-279	163	1.01	1.10	-0.09	0.92	0.30
280 and over	254	1.16	1.15	0.01	1.01	0.25

[1]SE = standard error.

Table 12. Actual and expected mean Periodontal Index for white adults, by sex and blood glucose levels: United States, 1960-62

Sex and blood glucose level in mg.%	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Less than 88	1,070	0.85	0.89	-0.04	0.96	0.13
88-107	1,149	0.97	0.97	0.00	1.00	0.15
108-127	897	1.10	1.07	0.03	1.03	0.13
128-147	618	1.13	1.13	0.00	1.00	0.24
148-167	395	1.23	1.26	-0.03	0.98	0.26
168-187	232	1.44	1.32	0.12	1.09	0.31
188-207	128	1.26	1.41	-0.15	0.89	0.30
208-227	49	1.71	1.48	0.23	1.16	0.59
228 and over	57	1.75	1.56	0.19	1.12	0.56
Men						
Less than 88	591	1.06	1.03	0.03	1.03	0.18
88-107	578	1.14	1.19	-0.05	0.96	0.20
108-127	420	1.36	1.32	0.04	1.03	0.18
128-147	272	1.28	1.40	-0.12	0.91	0.31
148-167	151	1.61	1.59	0.02	1.01	0.56
168-187	91	1.85	1.64	0.21	1.13	0.41
188-207	49	1.53	1.71	-0.18	0.89	0.52
208-227	20	2.29	1.55	0.74	1.48	1.13
228 and over	24	2.33	2.09	0.24	1.11	0.83
Women						
Less than 88	479	0.59	0.71	-0.12	0.83	0.14
88-107	571	0.79	0.72	0.07	1.10	0.15
108-127	477	0.84	0.82	0.02	1.02	0.13
128-147	346	1.00	0.90	0.10	1.11	0.27
148-167	244	0.99	1.05	-0.06	0.94	0.19
168-187	141	1.16	1.10	0.06	1.05	0.32
188-207	79	1.10	1.24	-0.14	0.89	0.32
208-227	29	1.39	1.44	-0.05	0.97	0.83
228 and over	33	1.36	1.19	0.17	1.14	0.71

[1]SE = standard error.

Table 13. Actual and expected mean Periodontal Index for white adults, by sex and diabetes diagnosis: United States, 1960-62

Sex and diabetes diagnosis	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Definite	51	1.52	1.39	0.13	1.09	0.56
Negative	4,551	1.05	1.05	0.00	1.00	0.10
Questionable	5	*	*	*	*	*
Men						
Definite	21	2.01	1.63	0.38	1.23	1.01
Negative	2,161	1.28	1.28	0.00	1.00	0.15
Questionable	3	*	*	*	*	*
Women						
Definite	30	1.22	1.23	-0.01	0.99	0.54
Negative	2,390	0.84	0.84	0.00	1.00	0.07
Questionable	2	*	*	*	*	*

[1]SE = standard error.

Table 14. Actual and expected mean Periodontal Index for white adults, by sex and urine glucose findings: United States, 1960-62

Sex and urine glucose findings	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Negative	3,888	1.00	1.03	-0.03	0.97	0.09
Trace	181	1.23	1.14	0.09	1.08	0.28
1	164	1.49	1.26	0.23	1.18	0.32
2	109	1.54	1.22	0.32	1.26	0.49
3	58	1.23	1.40	-0.17	0.88	0.47
4	105	1.55	1.27	0.28	1.22	0.42
Men						
Negative	1,785	1.21	1.25	-0.04	0.97	0.14
Trace	104	1.37	1.32	0.05	1.04	0.46
1	107	1.64	1.44	0.20	1.14	0.41
2	67	1.61	1.33	0.28	1.21	0.67
3	40	1.43	1.64	-0.21	0.87	0.74
4	57	1.91	1.50	0.41	1.27	0.46
Women						
Negative	2,103	0.82	0.84	-0.02	0.98	0.07
Trace	77	1.00	0.86	0.14	1.16	0.36
1	57	1.19	0.91	0.28	1.31	0.45
2	42	1.41	1.02	0.39	1.38	1.10
3	18	0.75	0.85	-0.10	0.88	0.43
4	48	1.18	1.05	0.13	1.12	0.75

[1] SE = standard error.

Table 15. Actual and expected mean Periodontal Index for white adults, by sex and nervous breakdown: United States, 1960-62

Sex and nervous breakdown	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
Yes	173	1.48	1.20	0.28	1.23	0.40
No	4,422	1.04	1.05	-0.01	0.99	0.10
Questionable	10	0.67	0.87	-0.20	0.77	1.02
Men						
Yes	60	1.86	1.46	0.40	1.27	0.56
No	2,121	1.27	1.28	-0.01	0.99	0.15
Questionable	4	*	*	*	*	*
Women						
Yes	113	1.26	1.05	0.21	1.20	0.42
No	2,301	0.83	0.84	-0.01	0.99	0.07
Questionable	6	*	*	*	*	*

[1]SE = standard error.

Table 16. Actual and expected mean Periodontal Index for white adults, by sex and nervous symptom score: United States, 1960-62

Sex and nervous symptom score	Number of persons	Mean Periodontal Index			Actual / expected	2 x SE[1]
		Actual	Expected	Difference		
Both sexes						
0	1,295	1.28	1.16	0.12	1.10	0.18
1	1,144	1.00	1.08	-0.08	0.93	0.12
2	948	1.00	1.04	-0.04	0.96	0.14
3	634	0.94	1.04	-0.10	0.90	0.14
4	374	0.94	1.00	-0.06	0.94	0.17
5	209	1.18	0.94	0.24	1.26	0.38
6	93	0.92	0.85	0.07	1.08	0.24
7	29	1.25	0.79	0.46	1.58	0.99
Men						
0	832	1.39	1.30	0.09	1.07	0.18
1	597	1.17	1.28	-0.11	0.91	0.17
2	397	1.29	1.26	0.03	1.02	0.22
3	225	1.13	1.30	-0.17	0.87	0.20
4	112	1.19	1.36	-0.17	0.88	0.39
5	54	1.92	1.17	0.75	1.64	0.71
6	25	1.00	1.09	-0.09	0.92	0.56
7	5	*	*	*	*	*
Women						
0	463	1.06	0.90	0.16	1.18	0.24
1	547	0.80	0.84	-0.04	0.95	0.16
2	551	0.78	0.89	-0.11	0.88	0.08
3	409	0.83	0.89	-0.06	0.93	0.15
4	262	0.83	0.84	-0.01	0.99	0.17
5	155	0.92	0.87	0.05	1.06	0.33
6	68	0.89	0.75	0.14	1.19	0.21
7	24	1.24	0.70	0.54	1.77	1.09

[1]SE = standard error.

APPENDIX I

SELECTED PROCEDURES OF THE HEALTH EXAMINATION SURVEY AND DEFINITIONS OF TERMS

The Health Examination Survey was intended at its inception, as it is today, to gather comparable information on the health status of the U.S. population. In keeping with this goal, its examination procedures are carefully standardized so that several examiners can obtain their findings more uniformly than would otherwise be possible. The findings contained in this report were collected by 62 physicians and five dentists. Both the examining physician and the examining dentist conducted his part of the health examination privately, with each unaware of the other's findings.

A description of selected procedures used during the adult examinations and definitions of selected terms appearing in this report follow.

PERIODONTAL INDEX (PI)[32]

A periodontal score is recorded for each tooth in the mouth, and the arithmetic average of all scores is the individual's Periodontal Index.

Scoring:

0 - *Negative.* There is neither overt inflammation in the investing tissues nor loss of function due to destruction of supporting tissues.

1 - *Mild gingivitis.* There is an overt area of inflammation in the free gingivae, but this area does not circumscribe the tooth.

2 - *Gingivitis.* Inflammation completely circumscribes the tooth, but there is no apparent break in the epithelial attachment.

6 - *Gingivitis with pocket formation.* The epithelial attachment has been broken and there is a pocket (not merely a deepened gingival crevice due to swelling in the free gingivae). There is no interference with normal masticatory function; the tooth is firm in its socket and has not drifted.

8 - *Advanced destruction with loss of masticatory function.* The tooth may be loose; may have drifted; may sound dull on percussion with a metallic instrument; may be depressible in its socket.

SIMPLIFIED ORAL HYGIENE INDEX (OHI-S)[33]

Selected surfaces of six teeth are used in making this estimation of oral hygiene status. For the purposes of this examination, each surface that is used, buccal or lingual, is considered to encompass half of the circumference of the tooth. The buccal surface of a molar, for example, is considered to include half of the mesial surface and half of the distal.

The posterior teeth used for the assessment are the first fully erupted teeth distal to the bicuspid area on each side of each arch. In most cases this will be a first molar but in others it may be a second or third molar. The buccal surfaces of upper molars and the lingual of lowers are examined. In the anterior portion of the mouth, the labial surfaces of the upper right central incisor and the lower left central incisor are examined. When one or both of these teeth are missing, the adjacent central incisor is substituted.

Examining for Oral Debris

The surface area covered by debris is estimated by running a number five explorer along the surface being examined and noting the occlusal or incisal extent of the debris as it is removed from the tooth surface and adheres to the explorer.

Scoring:

0 - No debris or stain present.

1 - (a) Soft debris covering not more than the gingival third of the tooth surface, or
(b) the presence of the extrinsic stains without debris regardless of surface area covered.

2 - Soft debris covering more than one-third but not more than two-thirds of the exposed tooth surface.

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

Examining for Oral Calculus

A number five explorer is also used to estimate surface area covered by supragingival calculus and to probe for subgingival calculus.

Scoring:

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, and/or the presence of individual flecks of subgingival calculus around the cervical portion of the tooth.
3 - Supragingival calculus covering more than two-thirds of exposed tooth surface and/or a continuous heavy band of subgingival calculus around the cervical portion of the tooth.

Calculating the Index

The debris scores are totaled and divided by the number of surfaces scored to obtain the Simplified Debris Index. The Simplified Calculus Index is determined similarly. The debris and calculus scores are then added to give the Simplified Oral Hygiene Index.

BLOOD PRESSURE MEASUREMENT

Three blood pressure measurements were made: the first just after the physician met the examinee; the second after completing the auscultation of the heart in the sitting position; and the third at the end of the examination. Blood pressures were taken while the examinee was sitting on the examining table. The nurse placed the middle of the cuff over the bulge in the upper left arm. The cuff was left on the arm between the first and second measurements, removed after the second, and returned for the third. The physician held the arm at the level of the atrium, with the nurse holding the Baumanometer at the physician's eye level. Using the bell of his stethoscope, the physician noted the pressure when the sound was first heard, when it first became muffled, and when it disappeared. All three measurements were recorded. The point at which Korotkoff's sounds disappeared was taken as the diastolic pressure. If the sounds did not disappear, the point of muffling, if distinctly heard, was used. Since the Baumanometer is scaled in intervals of 2 mm., measurements were so recorded. The blood pressure for each sample person was defined as the average of the three readings.

EXAMINATION OF THE OCULAR FUNDUS

Retinal fundoscopy was performed and the retinal vessels were graded according to the usual criteria currently observed by internists. This method of grading, it should be noted, is not as accurate as measurement of the vessels on photographs of the retina.

ELECTROCARDIOGRAM

The electrocardiogram (ECG) was obtained by a twin viso machine (Model 60-1300). Twelve leads were recorded: I, II, III, AVR, AVL, AVF, V_1-V_6. The electrocardiogram was read independently by three cardiologists according to criteria agreed upon in advance. The criteria are specified in another report.[31]

HYPERTENSION

Hypertension.—160 mm. Hg. or over systolic, or 95 mm. Hg. or over diastolic.

Borderline hypertension. —Below 160 mm. Hg. systolic and below 95 mm. Hg. diastolic, but not simultaneously below both 140 and 90 mm. Hg.

Normotension.—Below both 140 mm. Hg. systolic and 90 mm. Hg. diastolic.

(When aortic insufficiency was present or the heart rate was under 60, hypertension or borderline hypertension was defined by the diastolic pressure.)

HYPERTENSIVE HEART DISEASE

Definite.—One of the following:

1. Hypertension plus left bundle branch block or left ventricular hypertrophy by ECG. (By voltage criteria when 35 years of age or over. If under 35 years left ventricular or subendocardial ischemia must be present in addition to LVH by voltage criteria. No person under 35 had hypertension or borderline hypertension with this combination of ECG findings.)
2. Hypertension plus LVH or general cardiac enlargement (GCE) by X-ray.
3. A history of hypertension, currently on medication for hypertension, and LVH or GCE by X-ray and/or LVH by ECG.

Suspect.—One of the following:

1. Borderline hypertension plus LVH by ECG.
2. Borderline hypertension plus LVH or GCE by X-ray.

It will be noted that no allowance for treatment was made in the diagnosis of hypertension, but the criteria for HHD did admit cases without currently hypertensive blood pressures provided that they gave a history of hypertension under treatment. The criteria were invariant for age, race, and sex except for LVH by ECG.

CORONARY HEART DISEASE

Definite.—One of the following:

1. Myocardial infarction (MI) on ECG and/or definite angina (judgment of examining physician). Angina will not be ascribed to coronary heart disease if aortic stenosis or syphilitic heart disease is present.
2. History of myocardial infarction in judgment of examining physician and either left ventricular ischemia on the ECG or myocardial infarction on ECG outside criteria.

Suspect.—One of the following:

1. History of myocardial infarction in judgment of examining physician with no evidence of myocardial infarction or left ventricular ischemia on the ECG.
2. Suspect angina (judgment of examining physician).

A diagnosis of definite hypertensive heart disease and definite coronary heart disease was made by computer. The diagnostic procedure is described in previous reports.[31,34]

URINARY ALBUMIN

The urine specimen of male examinees (but not female) was tested for the presence of albumin, using the Bumin Test (sulfosalicylic acid test) (Ames Company Inc., Elkart, Indiana).

SERUM CHOLESTEROL

Determinations of total serum cholesterol concentration were made by a modified ferric-chloride procedure. The determinations were done in the Lipid Standardization Laboratory at the Communicable Disease Center, Atlanta, Georgia.[35]

GLUCOSE TOLERANCE TEST

Unless there was a clear history of diabetes under medical care, the examinee was offered a drink of 50 grams of glucose with lemon flavoring ("Dextol") which was diluted in 250 cc. of water. An hour after the glucose drink was given, a blood specimen was obtained by venipuncture. The blood specimen was shipped to the laboratory of the Diabetes Field Research Unit in Boston, where determinations of blood glucose concentrations were made, using the Somogyi-Nelson method. The HES glucose tolerance test, while differing in many respects from a standard clinical test for glucose tolerance, has been shown to provide a satisfactory equivalent.[36]

ITEMS RELATING TO MENTAL HEALTH

(Excerpts From HES-204, Medical History Self-Administered)

Have you ever had a nervous breakdown?	Yes	No	?
Have you ever felt you were going to have a nervous breakdown?	Yes	No	?
Do you ever have any trouble getting to sleep or staying asleep?	Yes	No	?
Have you ever been bothered by nervousness, feeling fidgety and tense?	Yes	No	?
Are you ever bothered by nightmares?	Yes	No	?
Do your hands ever tremble enough to bother you?	Yes	No	?
Are you troubled by your hands sweating so that you feel damp and clammy?	Yes	No	?
Have there ever been times when you couldn't take care of things because you just couldn't get going?	Yes	No	?

APPENDIX II

STATISTICAL NOTES

The Survey Design

The Health Examination Survey is designed as a highly stratified multistage sampling of the civilian, noninstitutional population, aged 18-79 years, of the conterminous United States. The first stage of the plan is a sample of the 42 primary sampling units (PSU's) from 1,900 geographic units into which the United States has been divided. A PSU is a county, two or three contiguous counties, or a standard metropolitan statistical area. Later stages result in the random selection of clusters of about four persons from a small neighborhood within the PSU. The total sample included 7,710 persons in the 42 PSU's in 29 different States. The detailed structure of the design and the conduct of the survey have been described in previous reports.[29,37]

Reliability in Probability Surveys

The methodological strength of the survey derives especially from its use of scientific probability sampling techniques and of highly standardized and closely controlled measurement processes. This does not imply that statistics from the survey are exact or without error. Data presented are imperfect for three important reasons: (1) results are subject to sampling error, (2) the actual conduct of a survey never agrees perfectly with the design, and (3) the measurement process itself is inexact, even when standardized and controlled. The faithfulness with which the study design was carried out has been analyzed in a previous report.[37]

Of the total of 6,664 sample white persons, 86 percent, or 5,719 persons, were examined. Analysis indicates that the examined persons are a highly representative sample of the adult civilian, noninstitutional white population of the United States. Imputation for the nonrespondents was accomplished by attributing to nonexamined persons the characteristics of comparable examined persons. The specific procedure used[37] consisted of inflating the sampling weight for each examined person to compensate for nonexamined sample persons at the same stand and of the same age-sex group. It is impossible, of course, to be certain that the extent of, for instance, periodontal disease is the same for the examined and the nonexamined groups.

There were 5,719 white persons who came in for examination. Of these 1,112 did not receive a periodontal score because they were edentulous, did not receive a dental examination, or did not receive a score for other reasons. Thus a total of 4,607 white persons received a periodontal score. The distribution of these persons by age and sex is given in table I.

Table I. Number of white persons examined and number on whom periodontal scores are available: Health Examination Survey, 1960-62

Age	Number examined		Number with periodontal scores	
	Men	Women	Men	Women
Total, 18-79 years	2,669	3,050	2,185	2,422
18-24 years	351	439	343	427
25-34 years	579	622	566	576
35-44 years	604	670	556	594
45-54 years	476	601	366	464
55-64 years	356	392	208	230
65-74 years	238	267	120	114
75-79 years	65	59	26	17

Sampling and Measurement Error

In this report and its appendixes, several references have been made to efforts to evaluate both bias and variability of the measurement techniques. The probability design of the survey makes possible the calculation of sampling errors. Traditionally the role of the sampling error has been the determination of how imprecise the survey results may be because they come from a sample rather than from measurement of all elements in the universe.

The task of presenting sampling errors for a study of the type of the Health Examination Survey is complicated by at least three factors: (1) measurement error and "pure" sampling error are confounded in the data—it is not easy to find a procedure which will either completely include both or treat one or the other separately, (2) the survey design and estimation procedure

are complex and accordingly require computationally involved techniques for calculation of variances, and (3) thousands of statistics come from the survey, many for subclasses of the population for which there are small numbers of sample cases. Estimates of sampling error are obtained from the sample data and are themselves subject to sampling error, which may be large when the number of cases in a cell is small, or even occasionally when the number of cases is substantial.

In the present report, estimates of approximate sampling variability for selected statistics are presented in tables 1-16. These estimates have been prepared by a replication technique which yields overall variability through observation of variability among random subsamples of the total sample. The method reflects both "pure" sampling variance and a part of the measurement variance.

In accordance with usual practice the interval estimate for any statistic may be considered the range within one standard error of the tabulated statistic, with 68-percent confidence, or the range within two standard errors of the tabulated statistic, with 95-percent confidence.

Expected Values

In tables 1-16, the actual mean Periodontal Index for each of the selected demographic variables is compared with the expected. The computation of expected rates was done as follows:

> Suppose that in a subgroup the Health Examination Survey estimates that there are N_i persons in the ith age group ($i = 1, 2, \ldots, 7$; sum of $N_i = N$). Suppose the Health Examination Survey estimates that the mean Periodontal Index for the United States in the ith age-sex group is X_i. Then the expected mean Periontal Index for the subgroup is
>
> $$\frac{1}{N} \sum_i N_i X_i$$

Comparison of an actual value for, say, hypertensive persons with the expected value for hypertensive persons is undertaken on the assumption that a meaningful statement can be made which holds, in some average way, for all persons who are hypertensive. This may or may not be true. Hypertensive persons may have higher values for young persons and lower values for old persons than are found in other blood pressure categories. In that case, an average comparison will obliterate one or both of these differentials. In arriving at the general conclusions expressed in the text, an effort was made to consider all the specific data, including data not presented in this report, but it must be recognized that balancing such evidence is a qualitative exercise rather than a quantitative one. The standard error of the difference between an actual and expected value may be approximated by the standard error of the actual value (tables 1-16).

Small Numbers

In some tables magnitudes are shown for cells for which sample size is so small that the sampling error may be several times as great as the statistic itself. Obviously in such instances the statistic has no meaning in itself except to indicate that the true quantity is small. Such numbers, if shown, have been included to convey an impression of the overall story of the table.

Tests of Significance

Tests of significance for mean periodontal scores by selected examination findings are performed in two ways. The first is to determine if the difference between the actual and expected value is greater than 2 times its standard error. For example, for women with hypertension, the difference between the actual and expected value is 0.45 and the standard error is 0.13 Since the difference is 3.5 times its standard error, it may be deemed statistically significant.

The second method is to examine the age-specific differences (not published) between the prevalence for the specified group and the prevalence for all persons. Thus for hypertensive women the mean PI for all age groups is more than the overall prevalence for these age groups. The probability of such an occurrence is less than 0.01, and the difference is considered statistically significant. In general where a difference is not statistically significant on the first test, the age-sex specific mean will fail the second test.

APPENDIX III

PERIODONTAL DISEASE, ORAL HYGIENE, AND BLOOD PRESSURE

It is true that poor oral hygiene is closely related to periodontal breakdown.[2] Yet it can still be argued that there is good reason not to assume that oral hygiene causes periodontal breakdown in as direct a way as the tubercle bacillus, for instance, causes tuberculosis. Although everyone may not concede in theory to the existence of a cause-and-effect relationship between the two dental conditions, every dentist knows by experience that, if favorable oral hygiene is lacking, there is little chance of halting pocket formation once it has begun. The relationship between oral hygiene and periodontal disease is not a simple one in any event, for if debris and calculus do in one sense cause alveolar bone loss, alveolar bone loss, on the other hand, causes in perhaps another sense poorer oral hygiene. This occurs because it becomes increasingly difficult to maintain good oral hygiene as the number and depth of periodontal pockets increase.

The oral hygiene status of sample persons who had at least one of six preselected teeth was assessed by the Simplified Oral Hygiene Index (OHI-S) (appendix I). Mean oral hygiene scores are not included in this report, but the mean oral hygiene score per person for each group of men and women whose periodontal scores are reported was examined. In general, the trend of oral hygiene scores paralleled that of periodontal scores, but the association of oral hygiene with various systemic findings tended to be of a lesser degree than that of periodontal disease.

Table II provides further detail on the interrelation of periodontal disease, oral hygiene, and blood pressure. The latter is, of course, a key factor in chronic vascular disease. The differences between actual and expected mean diastolic and systolic readings are given for men and women with little or no periodontal disease, moderate periodontal disease, and more advanced periodontal disease. Men and women are also classified by whether their oral hygiene is relatively good (lower OHI-S) or relatively poor (higher OHI-S).

The contents of the table indicate that, among people with either higher or lower oral hygiene scores, there is a tendency for high periodontal scores and high blood pressure readings to occur together and for low periodontal scores and low blood pressure readings to occur together. Except for one classification (men with high oral hygiene scores and moderate periodontal disease), systolic pressure tends to rise with increasingly severe periodontal disease.

Periodontal disease is less closely associated with diastolic blood pressure than with systolic blood pressure. Nevertheless, among people with either relatively good or relatively poor oral hygiene, men and women with little or no periodontal disease usually had lower mean diastolic pressures than those with moderate and severe periodontal disease. The difference between actual and expected diastolic readings of women with little or no periodontal disease and with low oral hygiene scores is statistically significant.

The contents of the table also show that people with poorer oral hygiene tend to have somewhat higher blood pressure readings than those with better oral hygiene. When periodontal and oral hygiene scores rise with increasing levels of a systemic condition, the interrelationship expressed cannot be readily explained.

Assuming that high blood pressure either causes or accelerates the formation of periodontal pockets, rising oral hygiene scores might reflect the reciprocal effect between increasingly severe periodontal disease and worsening oral hygiene. It can be said in furtherance of this assumption that periodontal disease and oral hygiene seem unlikely to have any effect at all on blood pressure. In addition, there is scarcely more reason to believe that blood pressure can directly affect oral hygiene. On the other hand, some states of mind such as mental disorders or those associated with "nerves" or "anxiety" could understandably lead to a greater neglect of oral hygiene. If this is the case, the association of nervous symptoms with periodontal disease would be a less direct one than that of nervous symptoms with oral hygiene. But whatever else the relationship between periodontal disease oral hygiene, and various systemic conditions may be, it is certainly a complex one, meriting more exploration than the present data permit.

Table II. Actual and expected mean diastolic and systolic blood pressures of white adults, by specified ranges of oral hygiene and severity of periodontal disease: United States, 1960-62

Range of oral hygiene and status of periodontal disease	Men				Women			
	Number of persons	Actual	Expected	Difference	Number of persons	Actual	Expected	Difference
DIASTOLIC								
Low OHI-S (0.0-2.0)								
No periodontal disease	472	77.01	77.83	-0.82	782	74.14	75.18	-1.04
Gingivitis	770	78.71	78.14	0.57	955	76.55	75.82	0.73
Pockets	214	79.76	80.00	-0.24	215	79.05	78.52	0.53
High OHI-S (2.1-6.0)								
No periodontal disease	16	73.82	76.92	-3.10	13	79.65	76.30	3.35
Gingivitis	271	77.59	78.27	-0.68	177	76.10	77.25	-1.15
Pockets	395	80.87	80.26	0.61	249	80.69	80.00	0.69
SYSTOLIC								
Low OHI-S (0.0-2.0)								
No periodontal disease	472	126.48	127.24	-0.66	782	119.82	121.31	-1.49
Gingivitis	770	128.02	127.95	0.07	955	124.31	123.50	0.81
Pockets	214	133.37	132.16	1.21	215	131.71	129.89	1.82
High OHI-S (2.1-6.0)								
No periodontal disease	16	125.83	127.01	-1.18	13	124.90	126.75	-1.85
Gingivitis	271	129.56	131.37	-1.81	177	125.71	127.43	-1.72
Pockets	395	136.37	134.98	1.39	249	134.85	133.35	1.50

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