Twelve variables of a group of edentulous subjects were compared with those of dentulous subjects in a probability sample of 408 persons, ages $\geq 20$ years, living in Tecumseh, Michigan. Bronchitis and heart disease were also considered in relation to edentulism and to the 12 variables in question.

It has been estimated that 18% of the adult population of the United States is edentulous. Epidemiologically, however, little is known about the edentulous. This report describes some of the characteristics of a group of edentulous persons and compares them with those of dentulous persons. Of the social and physiologic measurements obtained during the initial investigation in the Tecumseh Community Health Study, 12 variables were used for this comparison.

For the purposes of this report, an edentulous subject was defined as any adult, at least 20 years of age, who had no teeth visible in the oral cavity. According to previous reports, the percentage of adults who are edentulous, not including those who are edentulous in only one arch, rises from less than 10% at the age of 40 to more than 50% at age 65.

Reports of tooth mortality have indicated that dental caries accounts for 60% of all teeth lost in persons less than 35 years of age, whereas periodontal disease accounts for nearly 80% of all teeth lost in persons more than 35 years of age.

This investigation was supported in part by USPHS Fellowship 1-F3-DE-34, 946-01 from the National Institute of Dental Research and by USPHS Fellowship 1-F3-HE-33, 537-01 from the National Heart Institute, National Institutes of Health, Bethesda, Md.

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Materials and Methods

Tecumseh, Michigan, and its surrounding area were chosen as a suitable site to study a complete natural community, including the population and its biological, physical, and social environment. As part of this investigation, complete medical histories were taken and physical examinations, electrocardiograms, and selected laboratory tests were performed on the population during 1959 to 1960. In addition, Jamison examined a 10% geographically stratified random sample, comprising 801 people, to determine the prevalence and severity of periodontal disease. Of those eligible for the dental study, 690 (86%) participated.

The study sample of the present report consists of 408 persons, 20 years old or more, for whom dental and medical information was available. Of these, 84 people were edentulous and 324 were dentulous.

A preliminary analysis indicated that the dentulous persons could be described better if they were allotted to three groups on the basis of their periodontal disease index (PDI) score. The groups were constructed so that they would be roughly equal in size and so that one group would consist of persons with PDI scores greater than 4.0. These scores represented individuals with loss of epithelial attachment who were considered as having advanced periodontal disease (Table 1).

The variables used in the analyses were age, height, weight, relative weight, systolic blood pressure, diastolic blood pressure, blood glucose, serum cholesterol, serum uric acid, one-second forced expiratory volume ($FEV_1$), alcohol consumption, and cigarette consumption. The methodology and

* $FEV_1$ is a measure of pulmonary obstruction and used as an index of chronic obstructive lung disease.
procedures used in the investigation have been described.11

In a preliminary investigation of the study sample, these physiologic variables were significantly correlated with age \( (p<0.01) \): height, relative weight, systolic blood pressure, diastolic blood pressure, blood glucose, serum cholesterol, and FEV\(_1\). Weight and serum uric acid were significantly correlated with age \( (p<0.05) \).

When attempting any comparisons of these groups by a variable highly correlated with age, it was necessary to adjust for age. The simplest way to do this was to standardize the score for each variable of each subject to that which is typical of his age-sex group.12 Substitutions into this formula give an age-sex standardized score for each person:

\[
\frac{\text{observed score of individual subject}}{\text{mean score of his age-sex group}} + 10.0
\]

A value of 10.0 was added arbitrarily to the standardized score to eliminate negative values. The mean score and standard deviation of each age-sex group for each physiologic variable were available from the Tecumseh Community Health Study.11

The social variables (alcohol consumption and cigarette consumption) were not age-sex standardized in the analyses because the preliminary investigation revealed that these variables were not significantly correlated with age \( (0.50>p>0.25) \).

The analysis of variance test \( (F \text{ test}) \) was used to test the differences among the groups for both the physiologic and social variables.

Because bronchitis may be a possible source for focal infection, coronary disease may affect periodontal disease,9 and diabetes may increase susceptibility to infection, the prevalence of these diseases in the dentulous and edentulous groups was studied.

**Results**

**Age.**—The distribution of the study sample according to age and sex (Table 2) indicated that the mean age increased for both sexes from group I to group IV. The dentulous groups, groups I to III, were much younger as a whole \( (39.0 \text{ years}) \) than the edentulous group, group IV \( (55.3 \text{ years}) \). In the edentulous group, the women were 7.3 years younger on the average than the men; whereas, in the dentulous group, the women were only 0.4 years younger on the average than the men.

**Physiologic Variables.**—The means of the standardized scores and standard deviations of the observations of each group for

### Table 1

**Frequency Distribution of the Study Sample, According to Group**

<table>
<thead>
<tr>
<th>Group</th>
<th>PDI Score</th>
<th>No. per Group</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Men</td>
<td>Women</td>
</tr>
<tr>
<td><strong>Dentulous</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>I</td>
<td>0.0-2.9</td>
<td>28</td>
</tr>
<tr>
<td>II</td>
<td>3.0-3.9</td>
<td>43</td>
</tr>
<tr>
<td>III</td>
<td>4.0-6.0</td>
<td>83</td>
</tr>
<tr>
<td><strong>Edentulous</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>IV</td>
<td></td>
<td>39</td>
</tr>
</tbody>
</table>

### Table 2

**Age Distribution of the Study Sample, According to Group and Sex**

<table>
<thead>
<tr>
<th>Sex</th>
<th>20-29</th>
<th>30-39</th>
<th>40-49</th>
<th>50-59</th>
<th>60-69</th>
<th>70-79</th>
<th>&gt; 80</th>
<th>Total</th>
<th>Mean Age for Each Group</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Group I</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>12</td>
<td>14</td>
<td>1</td>
<td>1</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>28</td>
<td>30.4</td>
</tr>
<tr>
<td>Female</td>
<td>24</td>
<td>20</td>
<td>7</td>
<td>2</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>53</td>
<td>31.6</td>
</tr>
<tr>
<td><strong>Group II</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>10</td>
<td>19</td>
<td>8</td>
<td>6</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>43</td>
<td>35.8</td>
</tr>
<tr>
<td>Female</td>
<td>14</td>
<td>27</td>
<td>11</td>
<td>4</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>59</td>
<td>36.8</td>
</tr>
<tr>
<td><strong>Group III</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>7</td>
<td>23</td>
<td>30</td>
<td>13</td>
<td>8</td>
<td>2</td>
<td>0</td>
<td>83</td>
<td>44.0</td>
</tr>
<tr>
<td>Female</td>
<td>5</td>
<td>15</td>
<td>13</td>
<td>11</td>
<td>9</td>
<td>3</td>
<td>2</td>
<td>58</td>
<td>47.6</td>
</tr>
<tr>
<td><strong>Group IV</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>1</td>
<td>4</td>
<td>7</td>
<td>9</td>
<td>6</td>
<td>8</td>
<td>4</td>
<td>39</td>
<td>59.3</td>
</tr>
<tr>
<td>Female</td>
<td>1</td>
<td>11</td>
<td>11</td>
<td>6</td>
<td>6</td>
<td>10</td>
<td>0</td>
<td>45</td>
<td>52.0</td>
</tr>
<tr>
<td>Total</td>
<td>74</td>
<td>133</td>
<td>88</td>
<td>51</td>
<td>33</td>
<td>23</td>
<td>6</td>
<td>408</td>
<td>...</td>
</tr>
</tbody>
</table>
TABLE 3
MEANS OF THE AGE-SEX STANDARDIZED SCORES AND STANDARD DEVIATIONS OF THE OBSERVATIONS FOR NINE PHYSIOLOGIC VARIABLES, ACCORDING TO GROUP

<table>
<thead>
<tr>
<th>Variables</th>
<th>Group I</th>
<th></th>
<th>Group II</th>
<th></th>
<th>Group III</th>
<th></th>
<th>Group IV</th>
<th></th>
<th>Significant Differences Among Groups</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td>Mean</td>
<td>SD</td>
<td></td>
</tr>
<tr>
<td>Height</td>
<td>10.3</td>
<td>1.42</td>
<td>10.4</td>
<td>1.22</td>
<td>10.2</td>
<td>1.23</td>
<td>10.3</td>
<td>1.29</td>
<td>NS</td>
</tr>
<tr>
<td>Weight</td>
<td>9.6</td>
<td>0.92</td>
<td>9.9</td>
<td>0.87</td>
<td>9.9</td>
<td>1.02</td>
<td>9.9</td>
<td>1.04</td>
<td>NS</td>
</tr>
<tr>
<td>Relative weight</td>
<td>9.8</td>
<td>0.80</td>
<td>9.8</td>
<td>0.85</td>
<td>9.8</td>
<td>1.11</td>
<td>9.8</td>
<td>0.87</td>
<td>NS</td>
</tr>
<tr>
<td>Systolic blood pressure</td>
<td>10.0</td>
<td>1.10</td>
<td>9.9</td>
<td>1.07</td>
<td>9.8</td>
<td>0.93</td>
<td>9.9</td>
<td>0.97</td>
<td>NS</td>
</tr>
<tr>
<td>Diastolic blood pressure</td>
<td>9.9</td>
<td>0.86</td>
<td>10.0</td>
<td>1.08</td>
<td>9.8</td>
<td>0.86</td>
<td>9.8</td>
<td>0.94</td>
<td>NS</td>
</tr>
<tr>
<td>Blood glucose</td>
<td>10.0</td>
<td>0.97</td>
<td>10.0</td>
<td>1.02</td>
<td>10.1</td>
<td>1.10</td>
<td>9.9</td>
<td>1.21</td>
<td>NS</td>
</tr>
<tr>
<td>Serum cholesterol</td>
<td>9.9</td>
<td>0.80</td>
<td>10.1</td>
<td>1.21</td>
<td>10.0</td>
<td>0.88</td>
<td>10.1</td>
<td>0.92</td>
<td>NS</td>
</tr>
<tr>
<td>Serum uric acid</td>
<td>9.8</td>
<td>0.84</td>
<td>9.7</td>
<td>0.87</td>
<td>9.7</td>
<td>0.94</td>
<td>9.6</td>
<td>1.00</td>
<td>NS</td>
</tr>
<tr>
<td>FEV&lt;sub&gt;1&lt;/sub&gt;</td>
<td>9.9</td>
<td>0.88</td>
<td>10.0</td>
<td>0.91</td>
<td>9.7</td>
<td>1.03</td>
<td>9.7</td>
<td>0.86</td>
<td>Sig.*</td>
</tr>
</tbody>
</table>

NS, Not significant.
* Significant at 0.05 level (F<sub>t0.05</sub>).
no significant difference between the eden-
tulous (14%) and dentulous (16%) per-
sons.

The prevalence of coronary heart disease
was more than twice as great in the eden-
tulous persons, (6 of 84; 7%), compared
with the dentulous persons (9 of 324; 3%).
When the percentages were adjusted for age,
however, there was no significant difference
in the rates between the edentulous (4.5%)
and dentulous (2.8%) persons.

Diabetes was diagnosed only in one per-
son, an edentulous man; therefore, no com-
parisons could be made among the groups.

LENGTH OF TIME EDENTULOUS.—The
mean length of time the edentulous had been
without their natural teeth (Table 5) was
11.8 years for men and 12.8 years for wom-
en, with most persons (78%) having been
without their teeth for less than 20 years.

Discussion

The findings indicate that most differences
found between the edentulous and dentulous
groups are probably related to an age differ-
ence of 16 years. Using age-sex standardized
scores for the physiologic variables, there
were no differences among the groups with
respect to systolic blood pressure, diastolic
blood pressure, blood glucose, serum cho-
lesterol, and serum uric acid, all risk factors
associated with coronary heart disease.

The presence of bronchitis and low FEV₁
scores are indexes of impaired pulmonary
function, but the FEV₁ score is the more
sensitive index. When age was adjusted, the
edentulous group and the dentulous group
with the high PDI scores had lower scores
for FEV₁ than the dentulous groups with the
low and medium PDI scores. A relationship,
therefore, may exist between edentulism,
severe periodontal disease, and impairment
of pulmonary function.

Preliminary findings⁹ have indicated that
smoking is inversely related to FEV₁. The
dentulous men and the dentulous men

with the high PDI scores smoked more than
the men in the remaining groups. It seems
logical, then, that smoking may be a com-
mon factor to FEV₁ and to edentulism and
severe periodontal disease, although no cause
and effect can be stated.

Although an age effect might be attributed
to the increased use of alcohol in edentulous
men, an age effect was not seen in edentulous
women.

The analyses of the findings in this report
are restricted by small sample size and the
lack of information about periodontal dis-
ease prior to loss of teeth as well as about
the causes of edentulism. Only a prospective
longitudinal study of wide scope can provide
basic information, which is surprisingly ab-
sent from the dental literature. Areas of ex-
ploration that might be most fruitful in longi-
tudinal studies were emphasized in this re-
port.

Conclusion

A 10% probability sample from Tecum-
seh, Michigan, consisted of 408 people, 20
years old or more, of whom 84 were eden-
tulous. These 84 people were compared with
dentulous persons on the basis of selected
variables. For purposes of analyses, the
dentulous subjects were allotted into three
groups on the basis of their PDI scores.

Because the edentulous people were sig-
nificantly older than the dentulous people,
and all physiologic variables were signifi-
cantly correlated with age, the scores for
each physiological variable were age-sex
standardized.

Among the physiologic variables studied,
the FEV₁ differed significantly between the
dentulous and edentulous groups. When the
social variables were considered, edentulous
men consumed more alcohol than dentulous
men, but the reverse was true for women. In
men, the edentulous group and the dentulous
group with the greatest evidence of perio-
dental disease had significantly greater ciga-

---

TABLE 5

<table>
<thead>
<tr>
<th>Duration of Edentulism (Years)</th>
<th>Not Ascertained</th>
<th>Average Years of Edentulism</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sex</td>
<td>0-9 10-19 20-29 30-39 40-49</td>
<td></td>
</tr>
<tr>
<td>Male</td>
<td>16 16 3 1 2</td>
<td>1 11.8</td>
</tr>
<tr>
<td>Female</td>
<td>20 14 9 2 0</td>
<td>0 12.8</td>
</tr>
<tr>
<td>Total</td>
<td>36 30 12 3 2</td>
<td>1 12.3</td>
</tr>
</tbody>
</table>
rette consumption than men in the groups with medium or little evidence of periodontal disease.

When the prevalences of bronchitis and coronary heart disease were age-adjusted, there were no significant differences between the dentulous and edentulous persons.

The dental data were collected by Homer C. Jamison; the medical data are reported for the research staff of the Cardiovascular Research Center, The University of Michigan (Thomas Francis, Jr., director).

References