Relationship of Amount of Cigarette Smoking to Coronary Heart Disease Mortality Rates in Men

By ROBERT W. BUECHLEY, M.A., ROBERT M. DRAKE, M.D., M.P.H., AND LESTER BRESLOW, M.D., M.P.H.

Seven out of 8 previous reports indicate a relationship between morbidity or mortality from coronary heart disease and amount of cigarette smoking. Data from 2 California study groups, longshoremen and respondents to a household sample health survey, are presented to show similar relationships. In 4 studies showing mortality, the coronary heart disease death rates for men, in various age groups from 40 to 70 years, who smoked a pack of cigarettes or more per day, generally exceeded the corresponding rates for nonsmokers by from 1 to 7 deaths per thousand per year.

BERKSON, among others, has pointed out that lung cancer is not the only cause of death, for which increased mortality is observed among heavy cigarette smokers. While mortality from lung cancer is many times higher among heavy smokers than it is among nonsmokers, this increased risk pertains to a still relatively infrequent cause of death. The proportional excess of mortality associated with cigarette smoking is less in the case of coronary heart disease, but this increased risk pertains to the most common cause of death, especially of males in the middle years. The Hammond and Horn data indicate 4 times as many excess deaths, associated with cigarette smoking, from coronary heart disease as from lung cancer.

The purpose of this paper is to present, for comparison, the several studies that provide mortality rates by smoking class for coronary heart disease; and the several case-control studies that show coronary cases and controls by smoking class, including 1 study of each type, based on California data.

We consider that these findings, especially their consistency, raise the question whether cigarette smoking may carry greater risk for coronary heart disease than for lung cancer.

In the following pages the reported studies are summarized. As far as the varied reporting systems allow, these have been reduced to comparability. Comparisons may thus be made, and implications drawn, by each reader for himself.

PREVIOUS REPORTS

The positive relationship of smoking to coronary heart disease in men was first reported for Mayo Clinic patients by English, Willius and Berkson in 1940, following Pearl's 1938 report of an increase in total mortality with amount of cigarette smoking. Mills reported an excess of smokers, and greater amounts of smoking in cases of death from coronary heart disease. Gertler and White found more smokers among cases than among controls. Hegglin and Keiser in Switzerland found more and heavier smokers among male coronary cases. Hammond and Horn and Doll and Hill reported significantly higher mortality rates from coronary heart disease in heavier smokers. The Framingham study, reporting incidence of coronary disease by smoking class, had nonconfirmatory results.

The Study Group on Smoking and Health, sponsored by the American Cancer Society, the American Heart Association, the National Cancer Institute, and the National Heart Institute, recommended "... a research program of wide scope that would clarify the relationship and association between smoking..."
and cardiovascular disease.' Of particular importance, they considered, were "epidemiologic studies with appropriate consideration of the roles of other factors such as diet, physical activity, and blood lipids."\(^{12}\)

**California Findings**

Information on cigarette smoking and data concerning coronary heart disease are available for 2 California populations. The first is a population of 3,994 longshoremen who received a multiphasic screening examination in 1951 and for whom 5 years of follow-up have recently been completed.\(^{13, 14}\) The examined men were volunteers from a population of about 6,000 longshoremen, and selection bias occurred—the unexamined men showing higher mortality. The abbreviated question on current (1951) amount of cigarette smoking asked at this examination allows a division of the examined men into 2 classes: light or nonsmokers (less than a pack of cigarettes per day) and heavy smokers (a pack or more per day, or sometimes 2 packs). In the first 5 years of follow-up, 78 deaths from coronary heart disease* occurred among

\(^{*} \text{International Statistical Classification codes 420.0, 420.1, and 420.2.}\)
men in the examined group. California coronary age-sex-specific death rates applied to the examined population indicate 119 expected deaths. It is thus evident that the mortality rate of coronary heart disease was lower among the examined longshoremen than in a comparable age-sex population of California, and this finding has been discussed elsewhere. Of the observed deaths, 42 occurred among light or nonsmokers, compared to an expected 84, and 36 occurred among heavy smokers, compared to an expected 35. Similar proportions of observed to expected were not found for deaths from any heart disease other than coronary. Table 1 presents the basic data on coronary death rates for these men.

A retrospective case-control study, by questionnaire and interview, has been made of Californians reporting coronary disease to the California Health Survey; matched controls came from the same survey, which was based upon a representative sample of the State's population. The persons selected for restudy reported their coronary heart disease, and having survived at least the first coronary attack they also are in this sense a selected group. The 116 males with coronary disease reported a much higher mean amount of smoking, averaging about 16 cigarettes per day, than the 121 controls, who averaged about 10 cigarettes per day. Twenty-three male coronary patients were nonsmokers, compared to 51 matched controls. Table 2 gives the basic data for these men. Contrary to the trend in the prospective studies of mortality, the differences in amount of smoking are larger at the older ages for this case-control study of coronary heart disease morbidity.

Mortality Study Comparisons

Substantial agreement in results is shown by the 4 prospective studies presented in table 1. These investigations, including our own study of longshoremen, generally show higher mortality rates from coronary heart disease in each successively higher smoking class. As a simple measure of over-all increase, the difference in mortality rate between the nonsmokers and the heavy smokers in each study at each age has been noted in the last column of the table. Similar differences can, of course, be computed for the rates in the other smoking classes.

The 4 reported studies cannot be exactly reduced to any common denominator, as was done by Edwards for lung cancer, although the rates given in table 1 are a first step in so doing. Our study of longshoremen did not distinguish smoking categories in sufficient detail. Mill's study did not distinguish the various cardiovascular conditions. Doll and Hill lumped all types of smoking—cigar, pipe, and cigarettes—and reported on grams of tobacco smoked. Hammond and Horn avoided these difficulties, and their reporting as made in 1958 could well be taken as a model. They have adopted Doll and Hill's method of reporting person-years of exposure, which is necessary for computing commensurable rates.

Case/Control Ratios and Incidence Rate Comparisons

The studies presented in table 2, mostly case-control studies, are even more heterogeneous. The California study and the Framingham study both utilize cases identified in a representative sample of a specified population. Most of the others report on patients drawn from unknown population bases and compared with controls from the same or other bases. The Framingham study reports an incidence rate, while the other studies report numbers of cases and controls. Despite this heterogeneity, higher case-control ratios for coronary heart disease generally appear in successively higher smoking classes. Gertler and White discount the importance of this increase, although the difference they report is significant by the $x^2$ test. The Framingham investigators did not consider that the data in their original report demonstrated an association with amount of smoking, but they are continuing to accumulate more data. All other investigators note the relationship, Sigler to the extent of saying "...tobacco merely may have some influence in expediting the development of coronary heart disease in a small proportion of the population..."
TABLE 2.—Five Studies of Case-Control Ratios of Coronary Heart Disease in Men.
One Study of Incidence Rates

<table>
<thead>
<tr>
<th>Study</th>
<th>Age group</th>
<th>Numbers</th>
<th>Smoking class by daily amount</th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td></td>
<td>Cases/controls</td>
<td>Cases</td>
<td>Controls</td>
<td>Case-control ratio</td>
</tr>
<tr>
<td>California Health Survey</td>
<td>All ages</td>
<td>116/121</td>
<td>23</td>
<td>51</td>
<td>45</td>
<td>27</td>
</tr>
<tr>
<td></td>
<td>Under 45</td>
<td>5/6</td>
<td>0</td>
<td>1</td>
<td>0</td>
<td>1</td>
</tr>
<tr>
<td></td>
<td>45-54</td>
<td>24/24</td>
<td>2</td>
<td>8</td>
<td>25</td>
<td>5</td>
</tr>
<tr>
<td></td>
<td>55-64</td>
<td>8/43</td>
<td>8</td>
<td>15</td>
<td>53</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>65-74</td>
<td>32/34</td>
<td>7</td>
<td>17</td>
<td>41</td>
<td>10</td>
</tr>
<tr>
<td></td>
<td>75 and over</td>
<td>14/14</td>
<td>6</td>
<td>10</td>
<td>60</td>
<td>3</td>
</tr>
<tr>
<td>Heglin and Keiser</td>
<td>All under 50</td>
<td>153/151</td>
<td>10</td>
<td>38</td>
<td>26</td>
<td>79</td>
</tr>
<tr>
<td>English, Willius and Berkson</td>
<td>All ages</td>
<td>1000/1000</td>
<td>302</td>
<td>337</td>
<td>90</td>
<td>688</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>187/302</td>
<td>38</td>
<td>115</td>
<td>33</td>
<td>149</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>382/371</td>
<td>108</td>
<td>97</td>
<td>111</td>
<td>274</td>
</tr>
<tr>
<td></td>
<td>60 and over</td>
<td>431/327</td>
<td>156</td>
<td>125</td>
<td>125</td>
<td>275</td>
</tr>
<tr>
<td>Gertler and White</td>
<td>All under 40</td>
<td>90/139</td>
<td>9</td>
<td>32</td>
<td>28</td>
<td>81</td>
</tr>
<tr>
<td>Mills, 1950</td>
<td>All ages</td>
<td>352/1040</td>
<td>85</td>
<td>307</td>
<td>28</td>
<td>267</td>
</tr>
<tr>
<td></td>
<td>20-29</td>
<td>2/351</td>
<td>0</td>
<td>88</td>
<td>0</td>
<td>2</td>
</tr>
<tr>
<td></td>
<td>30-39</td>
<td>8/183</td>
<td>0</td>
<td>42</td>
<td>0</td>
<td>8</td>
</tr>
<tr>
<td></td>
<td>40-49</td>
<td>51/196</td>
<td>4</td>
<td>43</td>
<td>9</td>
<td>47</td>
</tr>
<tr>
<td></td>
<td>50-59</td>
<td>120/158</td>
<td>9</td>
<td>46</td>
<td>20</td>
<td>111</td>
</tr>
<tr>
<td></td>
<td>60-69</td>
<td>103/90</td>
<td>28</td>
<td>40</td>
<td>70</td>
<td>75</td>
</tr>
<tr>
<td></td>
<td>70 and over</td>
<td>68/62</td>
<td>44</td>
<td>48</td>
<td>92</td>
<td>24</td>
</tr>
<tr>
<td>Framingham</td>
<td>45/62</td>
<td>42/612</td>
<td>69</td>
<td>9</td>
<td>137</td>
<td>84</td>
</tr>
</tbody>
</table>

* Totals include 3 cases and 4 controls who smoked, but whose amount of smoking was not stated.
* Men who smoke pipe and/or cigar only are excluded from these recomputations.
* Any smoking combination that includes cigarettes.
* Persons of unknown smoking class have been excluded.
* Per thousand for 4 years.
8, 3, 7, 5, and 11: See references.
California Health Survey: unpublished data, California Department of Public Health.
Hegglin and Keiser to the extent of saying that "... smoking is now the most dangerous drug addiction."

Conclusions

The heterogeneity of populations, differing approaches and manner of reporting make impossible a good estimation of the magnitude of the relationship between cigarette smoking and coronary heart disease. We have abandoned our attempts to make such an estimate from a combination of studies by various authors. However, the extent of the relationship is generally indicated by the difference in death rate between nonsmokers and heavy smokers. These differences show a strong and consistent relationship between cigarette smoking and coronary heart disease mortality, at least in men 40 to 70 years of age. The difference in mortality between cigarette smokers and nonsmokers at different ages varies from 1 to 7 excess deaths from coronary heart disease per 1,000 men per year.

Smoking rates in the United States are high, and coronary death rates are also high, in comparison with many other countries. Further studies of their relationship are needed.

SUMMARIO IN INTERLINGUA

Le heterogeneitate del segmentos demo-graphic studi e le differentias inter le principios organisatori del studios e inter le formas in qua lor resultatos es reportate non permitte utilisar un combination de studios per varie autores como base de un solide estimation del grado de correlation inter le fumar de cigarettas e le incidentia de morbo cardiac coronari. Nos ha abandonate nostre effortis in iste direction. Tamen, le magnitude del correlation es reflectite de maniera general per le differentias del mortalitate ab morbo cardiac coronari inter non-fumatores e forte fumatores. Iste differentias exhibi un forte e systematic relation inter le fumar de cigarettas e le mortalitate ab morbo cardiac coronari, al minus in masculos de inter 40 e 70 annos de etate. Le differentia inter le mortalitates ab morbo cardiac coronari in fumatores de cigarettas e non-fumatores a varie etates amonta a un exceso de inter 1 e 7 mortes per anno in le fumatores.

Le incidentia del habitude de fumar in le Statos Unite es alte; le incidentia de morte ab morbo coronari es etiam alte. Le relation inter le duo require studios additional.

REFERENCES

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SCIENCE AND PHILOSOPHY

J. Arthur Thomson

British: professor of natural history, editor and author; 1861-1933

The philosophical outlook is synoptic; an all-round view. Science and philosophy are complementary. To the scientific thinker philosophy is of service in helping him to recognize the limitations of his task. On the other side, a modern philosophy must take account of all the far-reaching results of scientific inquiry. Thus an adequate interpretative system must have been receptive to all the influences of such conclusions as the principle of the conservation of energy, the doctrine of organic evolution, and the outstanding facts of heredity. Philosophy begins where the experimental and observational sciences leave off, but it does not follow that philosophy in its edifice must use the building-stones just as science hands them over. Thus the results of modern study of heredity need not be accepted in a form so crude that the inevitable outcome is fatalism. Similarly, when philosophy takes over from the biologist the formula of organic evolution that the present is the child of the past and the parent of the future, it is bound to scrutinize the concept of evolution and to show that it is no easy one. The general fact of evolution stands firmer than ever; but inquiry into the factors is still relatively young.—The Outline of Science, Vol. 4, p. 1165. From Great Companions. Readings on the Meaning and Conduct of Life from Ancient and Modern Sources. Vol. I, Boston, The Beacon Press, 1952.
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