

## 【講師オリジナル問題】

以下に引用した英文は、疫学（epidemiology）上の見地から喫煙の弊害について論じたものである。ここで疫学とは、疾病などが集団や地域に広まっていくさまを聞き取りや統計的資料によって調べ、原因を解明していく学問である。

この本文は抜粋であり、筆者はこの本文の前で、「物質 A が疾患 B の原因であること」を疫学的に示すための基準として、以下の 5 基準（5 criteria）を掲げている。

1. A を摂取した集団ほど B の危険が大きいこと。
2. AB の関係を調べた複数の調査に整合性があること。
3. A の摂取量が上がるにつれて B の程度も上がること。
4. AB の相関関係が社会全般に現れていること。
5. A が B を惹き起こす仕組みが、説得力をもって示されうること。

そして、これら 5 基準に対応して書かれたのが、本文中の各章：

1. *High Relative Risk*
2. *Consistency*
3. *A Graded Response To a Graded Dose*
4. *Temporal Relationship*
5. *Plausible Mechanism*

である。

以上を参考にこの英文を読み、後の問に答えよ。問 3～7 には日本語で答えること。なお、\*印をつけた本文中の語句については、本文のあとに脚注を施してある。

# *Cigarette Smoking: a Case Study of Epidemiology*

## 1. *High Relative\* Risk*

In the table on the next page, the quotient\* of observed deaths divided\* by expected deaths (those in the control group\*) gives the relative death rate. This value is a measure of risk.

Although smoking is associated with many more cases of heart disease than of lung cancer, lung cancer is the disease with the highest relative risk for smokers. The relative death rate from lung cancer is over 10 times greater in smokers than in non-smokers. This is strong evidence that smoking causes lung cancer. Cigarette smoking is estimated to be directly responsible for 83% of all lung cancer deaths (which totalled 143,000 in the U.S. in 1991).

This table gives the number of deaths from various causes in a prospective study\* of cigarette smokers ("observed deaths") compared with the number to be expected among non-smokers of the same ages ("expected deaths"). The differences between the two represent\* "excess deaths". The contribution of each disease to the total of excess deaths is given as the "percentage of excess". Note that coronary artery\* disease accounts for one half of the excess deaths in the smoking group.

Dividing the number of observed deaths by the number of expected deaths gives the "relative death rate" for each disease. This shows that smokers die of lung cancer 10 times as often (10.73, above) as do non-smokers, which is a very high relative risk. However, in both groups lung cancer is rarer than coronary artery disease. (Data from E. C. Hammond and D. Dorn, 1966.)

**Table**

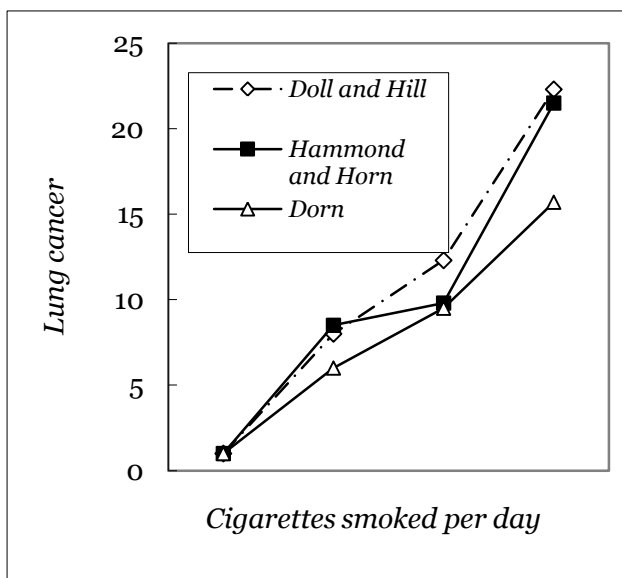
<b>Cause of Death</b>	<b>Observed Deaths</b>	<b>Expected Deaths</b>	<b>Excess Deaths</b>	<b>Percentage of Excess</b>	<b>Relative Death Rate</b>
<b>Total deaths (all causes)</b>	<b>7316</b>	<b>4651</b>	<b>2665</b>	<b>100.0</b>	<b>1.57</b>
(ア)	3361	1973	1388	(イ)	(ウ)
Other heart disease	503	425	78	2.9	1.18
Cerebrovascular lesions	556	428	128	4.8	1.30
Aneurysm & Buerger's disease	86	29	57	2.1	2.97
Other circulatory diseases	87	68	19	0.7	1.28
(エ)	397	37	360	13.5	<b>10.73</b>
Cancer of mouth, larynx, or esophagus	91	18	73	2.7	5.06
Cancer of the bladder	70	35	35	1.3	2.00
Other cancers	902	651	251	9.4	1.39
Gastric & duodenal ulcer	100	25	75	2.8	4.00
Cirrhosis of the liver	83	43	40	1.5	1.93
Pulmonary disease (except cancer)	231	81	150	5.6	2.85
All other diseases	486	453	33	1.2	1.07
Accident, violence, suicide	363	385	(オ)	-0.8	0.94

## 2. Consistency

Our confidence that A causes B is strengthened when different studies using different populations all show the same association.

The earliest studies of smoking were retrospective\*; that is, after a disease was diagnosed\*, the patient's smoking habits were determined. Later studies were prospective. A prospective study selects a population in good health and meeting any other desired criteria (smoking habits in this case) and follows it over a period of years to see what happens to its members.

This graph shows essentially the same relationship between smoking and deaths from lung cancer in three different groups (totalling over a million people) studied prospectively. Doll and Hill studied a group of British physicians. Dorn followed the health of a group of U.S. veterans\*. Horn studied 187,783 U.S. male volunteers. In each case the relative death rates are graphed as a function of number of cigarettes smoked each day (from zero at the left to over a pack at the right).



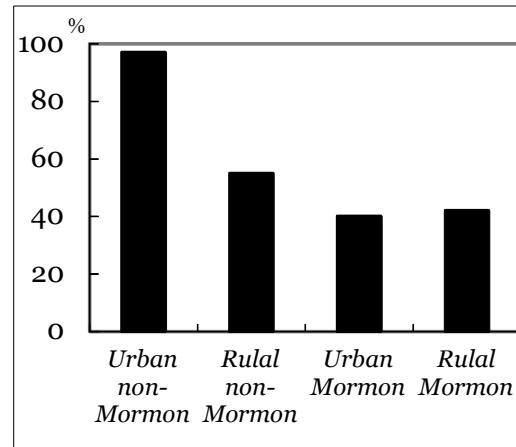
**Figure 1**

## 3. A Graded Response to a Graded Dose

All three studies graphed above show that the relative death rate from lung cancer increased with an increase in the average number of cigarettes smoked each day.

One goal of picking different groups to study is to avoid confounding\* variables. If, for example, all the groups studied lived in cities, it would be difficult to distinguish between the effects of smoking and the effects of general air pollution.

This graph compares the incidence of lung cancer among male Mormons\* and non-Mormons living in urban and rural areas of Utah. Male non-Mormons living in the city have a higher risk of developing lung cancer than those living in the country. Is this because of smoking or because of the pollution of urban air? It appears to be the former because Mormons show no such city vs. country difference, and cigarette smoking is prohibited for Mormons. Studies like these help to eliminate the effect of confounding variables. Probably less than 5% of lung cancer is caused by breathing polluted city air.

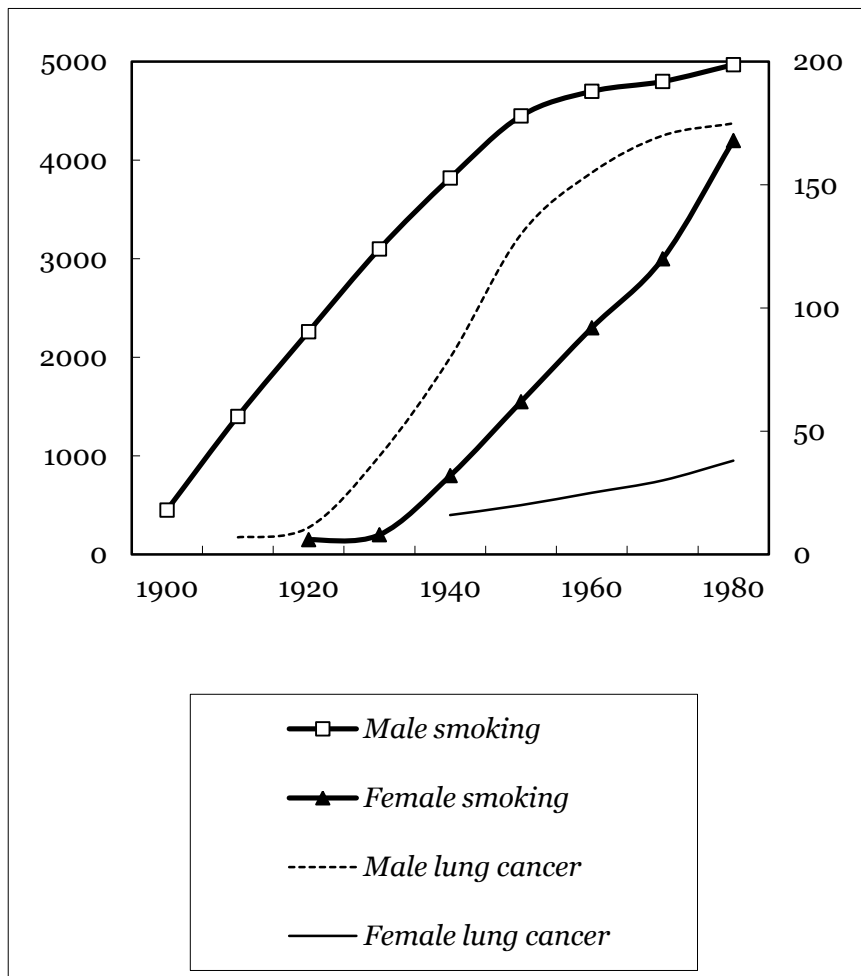


**Figure 2:** Lung cancer incidence to entire US population (=100%)

#### 4. Temporal Relationship

If A causes B, then exposure\* to A must have preceded\* the onset\* of B. Establishing cause-effect relationships for possible carcinogens\* has been particularly difficult because for cancers, the latency period between exposure and illness is often many years. Nonetheless\*, data such as those shown in the graph on the next page, provide (A)another strong link in the case against cigarettes.

In recent decades, sales of cigarettes in the U.S. have dropped, both on a per capita\* basis and in absolute numbers. Whereas half of adult males smoked in the mid-sixties, less than 1/3 do today. This change has already caused the rate of lung cancer in males to level off. Unfortunately, the rate is still rising for women (and in 1987 surpassed breast cancer as the leading cause of cancer deaths in U.S. women).



**Figure 3**

*The left scale: average number of cigarettes smoked per person per year.*

*The right scale: annual deaths from lung cancer per 100,000 populations.*

## 5. *Plausible Mechanism*

Over 40 different chemicals found in cigarette smoke cause an increase in cancer when given over several years to laboratory rats.

## 6. *So how strong is the case against\* cigarettes?*

Defenders of the tobacco industry frequently claim that no one has proved that cigarette smoking causes lung cancer. In one sense they are right. (B)Proof from epidemiology differs from proof in a laboratory experiment. What we have seen here is that the more closely we can meet the several criteria linking A and B, the more confident we can be that A causes B.

Few epidemiological studies have met these criteria better than those studying the statistical relationship between smoking and health. Smoking is probably the greatest single cause of preventable illness in the United States.

(出典：<http://users.rcn.com/jkimball.ma.ultranet/BiologyPages/E/Epidemiology.html>.)

ただし、出題上の都合により一部を省略・改変.)

### 脚注

relative: 相対的な, 比較しての. quotient: 割り算の商. divide: (数を数で) 割る.

control group: (比較観察用の) コントロールグループ. たとえば薬物投与実験においては, 薬物を投与せずにおくグループのこと.

prospective study: [疫学用語]「前向き研究; 前向きコホート研究」. 意味については『Consistency』の章を参照せよ.

represent: 表す, 意味する. coronary artery: (心臓の) 冠状動脈.

retrospective study: [疫学用語]「後ろ向き研究; 後ろ向きコホート研究」.

diagnose: (症状などを〇〇病と) 診断する; 原因を究明する.

veteran: (実戦参加を経て現役をしりぞいた,) 退役軍人・復員兵.

confounding: まぎらわしい, 混乱を招くような.

Mormon: モルモン教徒. 米国 Utah 州に多くが住み, 戒律にのっとり禁欲的な生活で知られる.

exposure: 危険などにさらされること. precede: 先に起こる. onset: 発病, 発症.

carcinogen: 発ガン性物質. nonetheless: それにもかかわらず.

per capita: 一人あたりの. case against ~: ~に不利となるような指摘・事例.

問 1. 表の (ア) ~ (オ) を埋めよ。(ア) (エ) には『High Relative Risk』の章から病名を選んで英語のまま入れ、それ以外には数値を入れること。

問 2. 次の各文章が、本文の内容に合っていれば○を、合っていなければ×を記入せよ。

- (1) たばこを吸う人たちも吸わない人たちも、肺ガンより冠状動脈疾患で死亡することが多い。
- (2) 初期の疫学においては、健康な集団を選んで追跡調査する、という研究がなされていた。
- (3) 肺ガンの原因としては喫煙のほかにさまざまな要素が考えられるため、喫煙を肺ガンの主因と特定することは事実上不可能である。
- (4) こんにち、男性の喫煙率は下がってきているが、男性が肺ガンで死亡する率にはいまだ変化が見られない。
- (5) たばこの煙に含まれる化学物質がガンをひきおこすことは、ラットを使った実験でも観察されている。
- (6) 喫煙と健康との関係を統計的に考察した本文中の諸研究は、疫学における 5 基準をよく満たしているとは言いがたい。

問 3. Figure1 からいえることを、本文をもとに 2 点あげよ。

問 4. モルモン教徒集団に言及したくだり(p5)を読んで以下の(1)(2)に答えよ。

- (1) 標本集団としてモルモン教徒が選ばれているのはなぜか。(80 字以内)
- (2) 調査の結果、何がわかったか。(80 字以内)



問 5. *Temporal Relationship* の項を読んで以下の(1)(2)に答えよ.

- (1) Figure3 で男性のグラフ 2 本を見くらべると, 年間一人あたりの喫煙本数が 1900 年ごろ以降ずっと上昇しているのに対し, 肺ガンでの死亡率が上昇しはじめたのは 1920 年ごろであることがわかる. このことに最も強く関連すると思われる一文を和訳せよ.
- (2) 下線部(A)“another strong link”とは「Table や Figure1, 2 に見られるのとは別の, Figure3 に見られる強い相関」というほどの意味であるが, 具体的には何を指すと考えられるか. (120 字以内)

問 6. 下線部(B) “Proof from epidemiology differs from proof in a laboratory experiment”とあるが, 疫学的な立証は実験データによる立証とどう違うか. 本文をもとに述べよ. (150 字以内)

問 7. 本文を読んで考えるところを述べよ. (300 字以内)