The Health Effects Of Smoking

Seminar "How do I lie with statistics"

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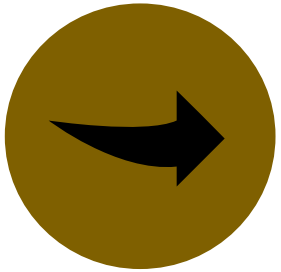
Marina Walther

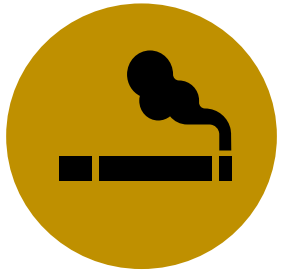
B.Sc. Computer Science, 5th semester

University of Heidelberg

Content



TIME LAPSE OF EVENTS



“THE CIGARETTE CONTROVERSY”

SECONDHAND SMOKE

CONCLUSION

The first appearance of evidence

Public statements:

- 1920s:
  First appearance of evidence smoking ~ lung cancer

- 1920-1940:
  Angel Honorio Roffo (chemist) published about inducing cancer by applying tar onto cells

Internal thoughts of the industry:

- *1939:* "We have been following Roffo's work for some time, and I feel that it is rather unfortunate that a statement such as his is widely disseminated."

The 1950s

Public statements:

- 1954: A Frank Statement to Cigarette Smokers published in major U.S. newspapers
- George Weissman: "If we had any thought or knowledge that in any way we are selling a product that was harmful to consumers, we would stop business tomorrow"

- 1958: Cornfield et al. about "Smoking and Lung Cancer"
  - Breakthrough for medical studies
  - Turning point

Internal thoughts:

→ Leading industry met to develop a public relations firm and response

1953: "studies of clinical data tend to confirm the relationship between heavy and prolonged tobacco smoking and incidence of cancer of the lung"

The Ongoing "Controversy"

Public statements:

- 1968: R.J. Reynolds letter to elementary school teacher
  "[…] medical science has been **unable to establish that smoking has a direct causal link** with any human disease"

- 1982: R.J. Reynolds before Congress
  "[...] science to date and over a hundred million dollars of our industry's money indicates that **there is no causal link**."

Internal thoughts:

- 1961: confidential report to L&M
  "[…]biologically active materials present in cigarette tobacco. These are a) **cancer causing**; b) cancer promoting; c) poisonous"

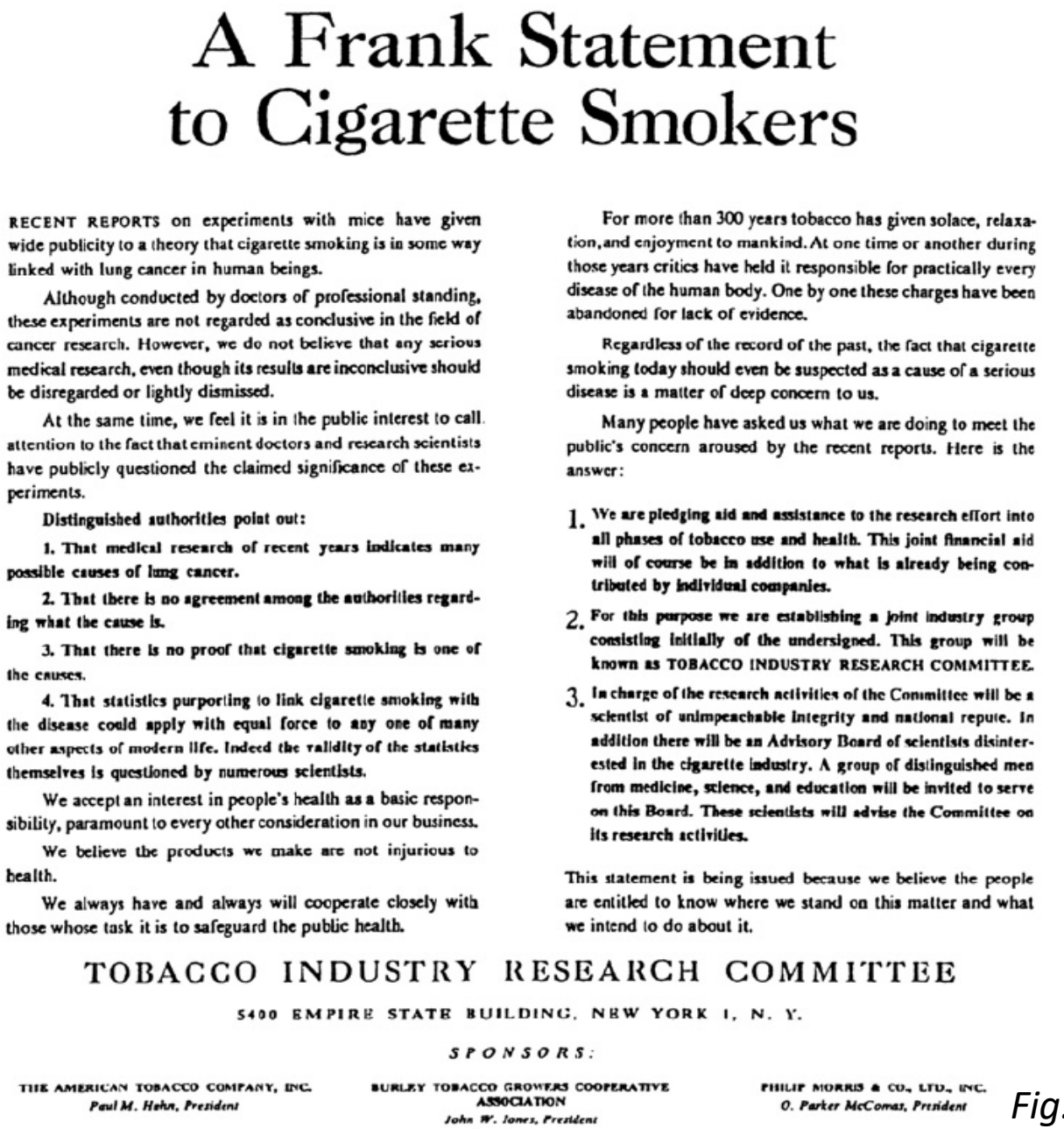
- 1969: Brown and Williamson executives
  "**Doubt is our product**[…] If we are successful in **establishing a controversy** […], then there is an opportunity to put across the real facts about health and smoking"

The 1990s

- 1994:
  heads of the major U.S. tobacco companies testified before Congress their pro-cigarette image
  https://www.youtube.com/watch?v=e_ZDQKq2F08&feature=emb_logo

- 1994:
  confidential documents leaked to public

- 1998:
  lawsuits on behalf of the U.S. state governments lead to the Master Settlement Agreement



A Frank Statement to Cigarette Smokers

RECENT REPORTS on experiments with mice have given wide publicity to a theory that cigarette smoking is in some way linked with lung cancer in human beings.

Although conducted by doctors of professional standing, these experiments are not regarded as conclusive in the field of cancer research. However, we do not believe that any serious medical research, even though its results are inconclusive should be disregarded or lightly dismissed.

At the same time, we feel it is in the public interest to call attention to the fact that eminent doctors and research scientists have publicly questioned the claimed significance of these experiments.

Distinguished authorities point out:

1. That medical research of recent years indicates many possible causes of lung cancer.

2. That there is no agreement among the authorities regarding what the cause is.

3. That there is no proof that cigarette smoking is one of the causes.

4. That statistics purporting to link cigarette smoking with the disease could apply with equal force to any one of many other aspects of modern life. Indeed the validity of the statistics themselves is questioned by numerous scientists.

We accept an interest in people's health as a basic responsibility, paramount to every other consideration in our business.

We believe the products we make are not injurious to health.

We always have and always will cooperate closely with those whose task it is to safeguard the public health.

For more than 300 years tobacco has given solace, relaxation, and enjoyment to mankind. At one time or another during those years critics have held it responsible for practically every disease of the human body. One by one these charges have been abandoned for lack of evidence.

Regardless of the record of the past, the fact that cigarette smoking today should even be suspected as a cause of a serious disease is a matter of deep concern to us.

Many people have asked us what we are doing to meet the public's concern aroused by the recent reports. Here is the answer:

1. **We are pledging aid and assistance to the research effort into all phases of tobacco use and health. This joint financial aid will of course be in addition to what is already being contributed by individual companies.**
2. **For this purpose we are establishing a joint industry group consisting initially of the undersigned. This group will be known as TOBACCO INDUSTRY RESEARCH COMMITTEE.**
3. **In charge of the research activities of the Committee will be a scientist of unimpeachable integrity and national repute. In addition there will be an Advisory Board of scientists disinterested in the cigarette industry. A group of distinguished men from medicine, science, and education will be invited to serve on this Board. These scientists will advise the Committee on its research activities.**

This statement is being issued because we believe the people are entitled to know where we stand on this matter and what we intend to do about it.

TOBACCO INDUSTRY RESEARCH COMMITTEE

5400 EMPIRE STATE BUILDING, NEW YORK 1, N. Y.

SPONSORS:

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Fig.2

"The Cigarette Controversy"

How the tobacco industry created it

The tobacco industry`s strategy

- Research funded by tobacco industry:
  - Likely to draw conclusions in favour of the industry
  - Poorly designed, barely peer-reviewed

- Studies designed and supervised by:
  - industry personnel
  - industry lawyers and consultants

- Finally publish research:
  - Sole, “scientific” author → no “industrial” co-authors
  - No clear disclosure of industrial / financial dependencies
  - Disseminate first to lay press then to policy makers

- Minimization and suppression of unfavourable results

Cornfield et al. – paper from 1958

- Points out recorded facts
- Defines more precisely inadequacies of information → further research
- Cited studies with similar conclusion:
  - Retrospective: 21 independent groups from 8 countries
  - Prospective: 3 independent groups from 2 countries

→ Partly origin of causal reasoning in today`s epidemiology

Effect of Aging

Criticism	Cornfield's response	Today's practices
• Population ages • Effect of aging leads to a higher lung cancer rate	➢ Issue was investigated by **age adjusted rates** ➢ E.g. Dunn's study of the U.S. population: 1930: 4 deaths per 100.000 males 1951: 24 deaths per 100.000 males & only 1/6 is due to aging population ➢ Similar findings for England and Wales ➢ Also: Age effect does not affect age-specific lung cancer rates	✓ Age standardization → based on standard populations (direct method) → based on standard rates (indirect method) ✓ Stratification ✓ Used for any other static variable /**Confounders**

Improvement in Diagnostic Factors

Criticism	Cornfield's response	Today's practices
Improvement: • Better diagnostic measures • More complete reporting → Responsible for increasing lung-cancer rates	➢ "special features" of lung cancer increase ➢ Careful study by Gilliam: increase instead of ♂ 26-fold → 4-fold ♀ 7-fold → 30% ➢ Copenhagen Tuberculosis Station Data ➢ Necropsy and mortality data agree	✓ Hard to measure ✓ Current example: valuation of medical screening

Socioeconomic status

Criticism	Cornfield's response	Today's practices
• Smoking is not a class dependent appearance • Lower income classes have higher lung cancer rates • How come, the poorer the people, the higher the lung cancer incidence?	➢ Tobacco smoke is not the sole cause for lung cancer ➢ Population exposed to other established agents is too small ➢ Effects of smoking history are greater than effects of socioeconomic class	✓ Control Confounding: a) Study design • Restriction of participants • Matching • Randomization b) Analysis of results • Adjustment (standardization, stratification) • Multiple Regression

Special Population Groups

Haag and Hanmer-study:

- 9 processing plants of the American Tobacco Company
- Above average proportion of smokers
- No higher mortality for respiratory cancer/ coronary disease compared to Virginia and North Carolina

Fig.7

The Haag Hanmer Study - Problems

- Very small sample group → too small to draw conclusions on respiratory cancer
- Study Population (= Empolyees) do not represent general population → Comparison unapplicable
- No data provided for smoker/non smoker proportion

Selection of study groups

Today: Selection Bias

Criticism

- Survey of population at a given instant of time → misleading results
- 20/21 retrospective studies' control group: patients without lung-cancer

Study population consists of hospital patients (only):

- Person with two complaints = more likely hospitalized than one complaint
- Patients do not represent the smoking habits of general population

Cornfield's response

- ➢ All studies have the same outcome: Often referred to different design of other studies
- ➢ Higher mortality in later periods of studies

→ Direction of bias yield an underestimate of smoking-health -association

Accuracy of information

Today: Information Bias

Criticism	**Cornfield's response**

• Error occurs:
  • Ascertainment of smoking habits
  • Diagnosis of disease
 	
• Illness biases response of patients about their smoking habits
	Ascertainment of Smoking habits:
	➢ Consistent figures on tobacco production and taxation
	➢ Study of accuracy of replies: answers not accurate but → few heavy smokers classified as light smokers
	
	Diagnosis of disease:
	➢ Major for prospective method
	➢ If overestimation → Underestimated association of smoking and other diseases

Interpretation of Results

smoking → lung cancer

Causal Hypothesis

common cause → lung cancer, smoking

Constitutional Hypothesis

lung cancer → smoking

For the sake of logical completeness

The possible constitutional factor

- Most popular: Gene
- E.g. proposed by Fisher: 51 monozygotic twins have more similar smoking habits than 33 dizygotic twins

But:

- 9-fold greater lung-cancer risk for cigarette smokers

prevalence(factor) among smokers ≥

9 * prevalence(factor) among non-smokers

Cornfield's inequality

Cornfield's inequality

D:= presence of the disease
B:= presence of causal agent
$\bar{B}$:= absence of causal agent
A:= presence of un-observed agent
$\bar{A}$:= absence of un-observed agent

Risk Ratios

$$R_0 = \frac{P(D|B)}{P(D|\bar{B})}$$

$$R_u = \frac{P(D|A)}{P(D|\bar{A})}$$

$$f_1 = P(A|B)$$

$$f_0 = P(A|\bar{B})$$

Assuming: D independent of B given A:

$$p = P(D|\bar{A}, B) = P(D|\bar{A}, \bar{B}) = P(D|\bar{A})$$

$$pR_u = P(D|A, B) = P(D|A, \bar{B}) = P(D|A)$$

Cornfield's inequality (2)

Or: $R_u \to \infty$

$$R_0 = \frac{P(D|B)}{P(D|\bar{B})} = \frac{P(D,A|B) + P(D,\bar{A}|B)}{P(D,A|\bar{B}) + P(D,\bar{A}|\bar{B})}$$

$$= \frac{P(D|A,B)P(A|B) + P(D|\bar{A},B)P(\bar{A}|B)}{P(D|A,\bar{B})P(A|\bar{B}) + P(D|\bar{A},\bar{B})P(\bar{A}|\bar{B})}$$

$$\overset{\bigstar}{=} \frac{pR_u f_1 + p(1-f_1)}{pR_u f_0 + p(1-f_0)} = \frac{R_u f_1 + (1-f_1)}{R_u f_0 + (1-f_0)}$$

$$R_0 \leq \frac{f_1}{f_0}$$

$$R_0 \leq R_u$$

For f_1=1 and f_0=0 and a fixed $R_u \geq 1$

Why is it so hard to prove causation?

- Experiments on human subjects over 30-60 years → ethnically inconceivable
- Still non-smoker lung cancer patients & non-cancerous smokers
- All evidence together makes the causal hypothesis seem much more likely

Fig. 7

Fig. 3

Second-hand tobacco smoke (“SHS”)

Recycling strategies

An example: the 16 cities study

- Designed , executed, supervised by R.J. Reynolds Tobacco Company scientists
- SHS exposure at work vs. at home
- Published in 1996 by Jenkins as sole author

  → no disclosure of the full involvement of R.J. Reynolds

- Conclusion of the study:
  - Home SHS exposure **4x greater** than workplace SHS exposure

  → No regulations necessary due to insignificant impact

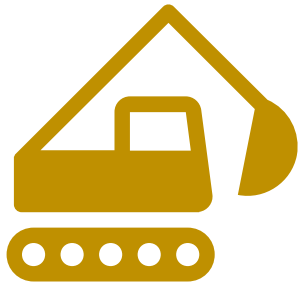
¯_(ツ)_/¯

Determination of exposure to SHS

- **Innovative methods:**
  - Sampling pump during work
  - Separate pump at home
  - Analysis based on chemical markers

- Diary of the number of cigarettes being smoked:
  - Within 100 ft of the subject
  - Every hour during air sampling

Let`s dig into their dirt



- **Omitted data** on the “diary-data”
- Response why the data was omitted:
  - the raw data are self-reported observations
  - value unreliable

- What the data really showed:

  Significant association between number of cigarettes being smoked and concentration of SHS components

Definition of a “smoking workplace”

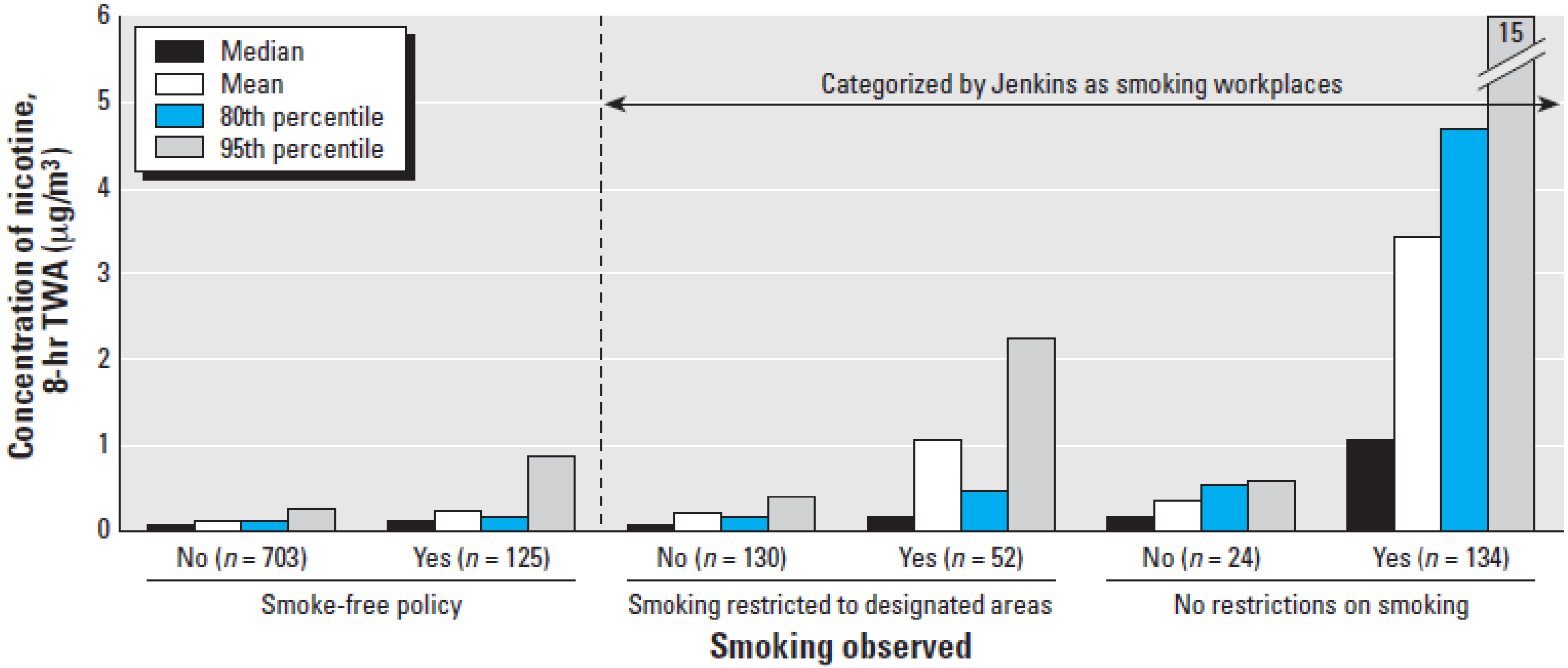


Fig.5

Inappropriate comparisons of cells

- Study's conclusion: "Home was 4-fold greater source for SHS exposure"

- Conclusion is based on comparison:
  - A: People who work with smokers
  - B: People who live with smokers

Smoking Home / Smoking Workplace	Smoking Home/ Non-Smoker Workplace
Non-Smoking Home / Smoking Workplace	Non-Smoking Home / Non-Smoking Workplace

→All data is grouped

→**Not suitable** for the question how workplace exposure adds to the total exposure for individuals

Different analysis – different results

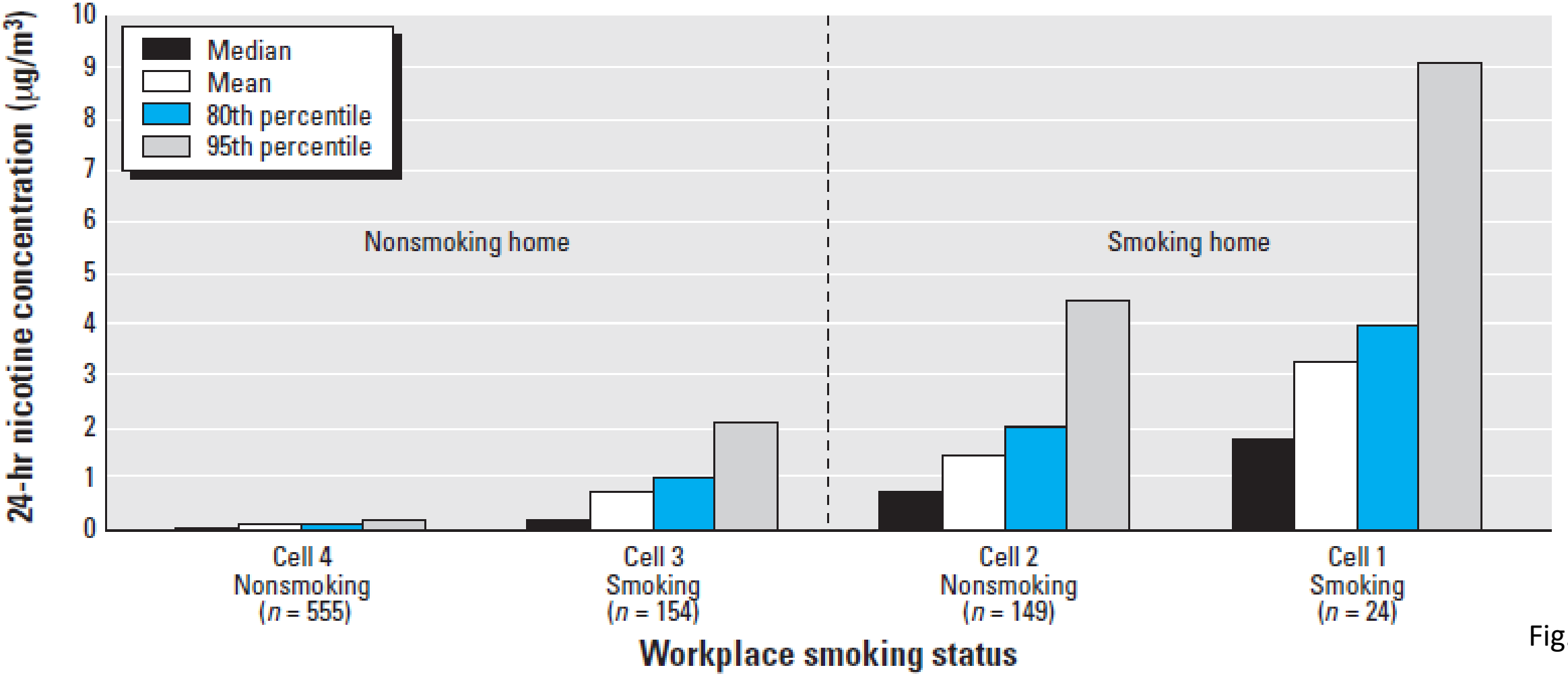


Fig.6

Conclusion

- Industry funded research:
  - Is not always bad, but often
  - “Do not trust a study you did not manipulate yourself”

- Critics demand transparency:
  - Full disclosure of financial involvement
  - Full disclosure of industrial involvement

Image Sources

Title image: https://www.history.com/.image/t_share/MTU4NDI2ODU5NTc3NjgxMjUy/lucky_20679.jpg

Video: https://youtu.be/e_ZDQKq2F08

2: https://en.wikipedia.org/wiki/A_Frank_Statement

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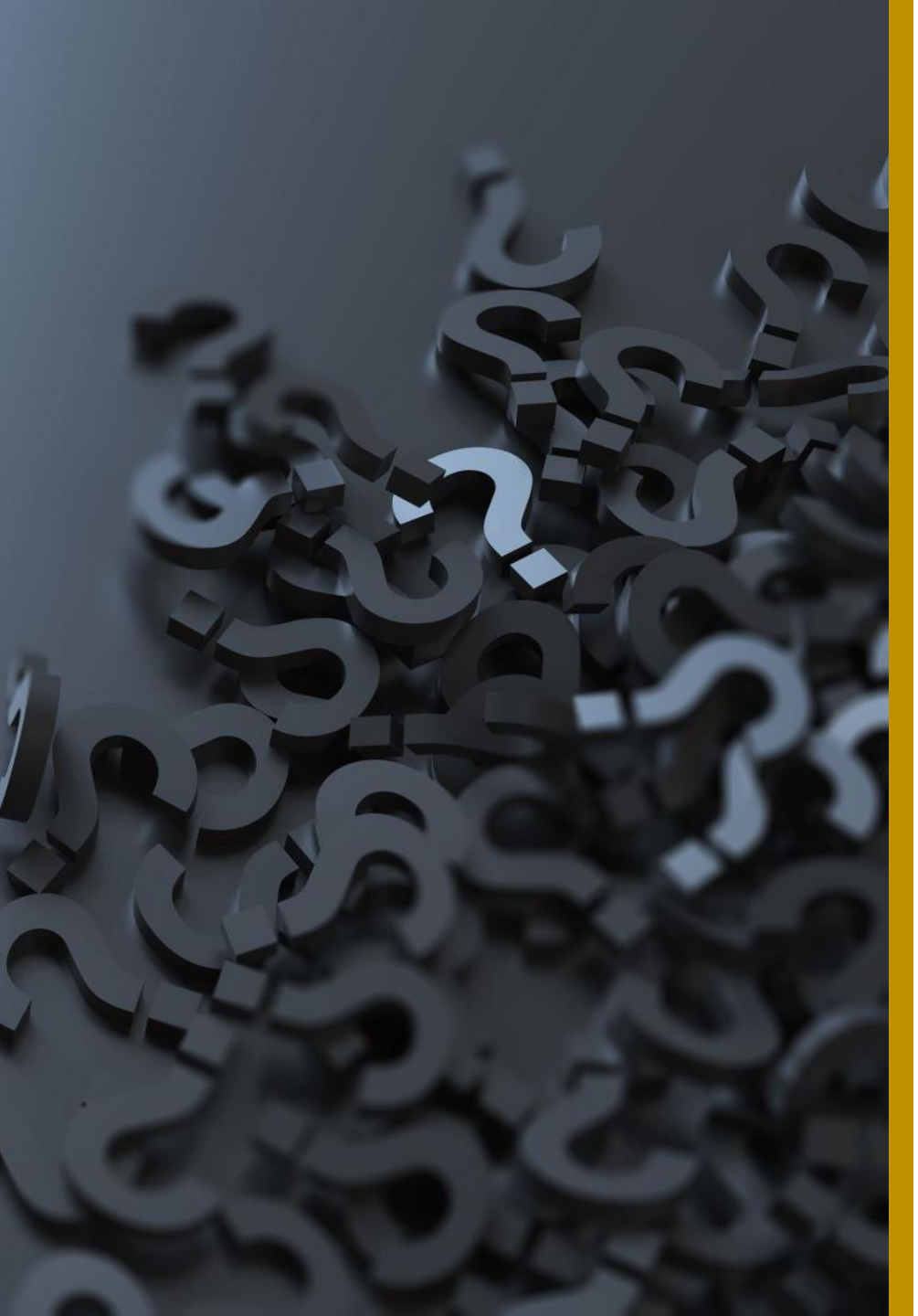

Thank you for your attention!

Discussion, questions and answers