



Statistical Surprises and Absurdities

"There are three kinds of lies: lies, damned lies, and statistics."

"When in doubt, tell the truth."

Mark Twain



Surprises and Absurdities

- Surprise
 - A legitimate result that contradicts our expectation
- Absurdity
 - An unexpected result that leads to a conclusion that isn't true
- Lying with statistics
 - A statement which uses statistics to convey a misleading result



Sample Bias

- The average salary of our graduates is \$100,000 per year... or not
 - Whose address or phone number is the school likely to have: Alumni club members? Or homeless graduates?
 - Who is most likely to respond: successful alumni or unsuccessful alumni?
 - Which is more likely: respondents who overstate their income, or who understate their income?
 - Accurate responses don't affect the bias.
- Discussion: can you think of other sources of sample bias?

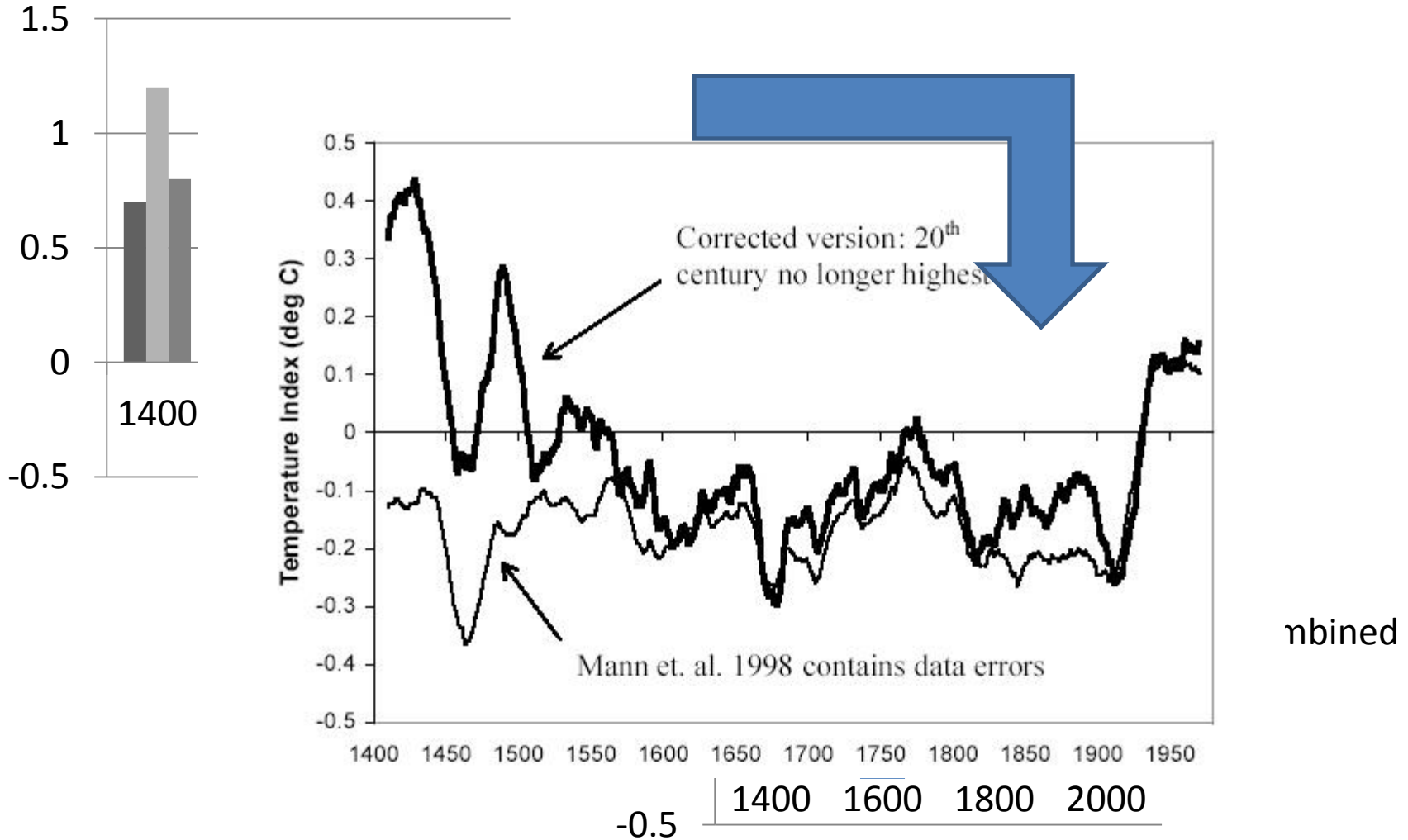


Averages, Averages

- Salaries: \$50,000; \$50,000; \$70,000; \$500,000.
- Which statement is correct?
 - A: Average salary \$ 50,000
 - B: Average salary \$167,500
 - C: Average salary \$ 60,000
- Which is right?
 - D: All of the above
 - A: mode
 - B: arithmetic mean
 - C: median



Selective Data Weighting





Selective Reporting

- “8 out of 10 dentists prefer Smiley Toothpaste”
- Small sample sizes also a way to tell a lie

Sample	Smiley	Other
1	2	8
2	4	6
3	6	4
4	5	5
5	8	2

Missing Information

- True perhaps, but most doctors don't smoke!
 - Was "I don't smoke" offered as a choice?
- On any list, *something* must be first

According to repeated nationwide surveys,

More Doctors Smoke **CAMELS** than any other cigarette!

Doctors in every branch of medicine were asked, "What cigarette do you smoke?" The brand named most was Camel!

You'll enjoy Camels for the taste, smooth as the finest tobacco, strong, clean, Camels have cool, moist mildness, quick, alert push, and a flavor unmatched by any other cigarette. Make this your habit now. Smoke only Camels for 30 days and see how well Camels please your taste. You will find that your throat as you steadily smoke. You'll see how enjoyable a cigarette can be!

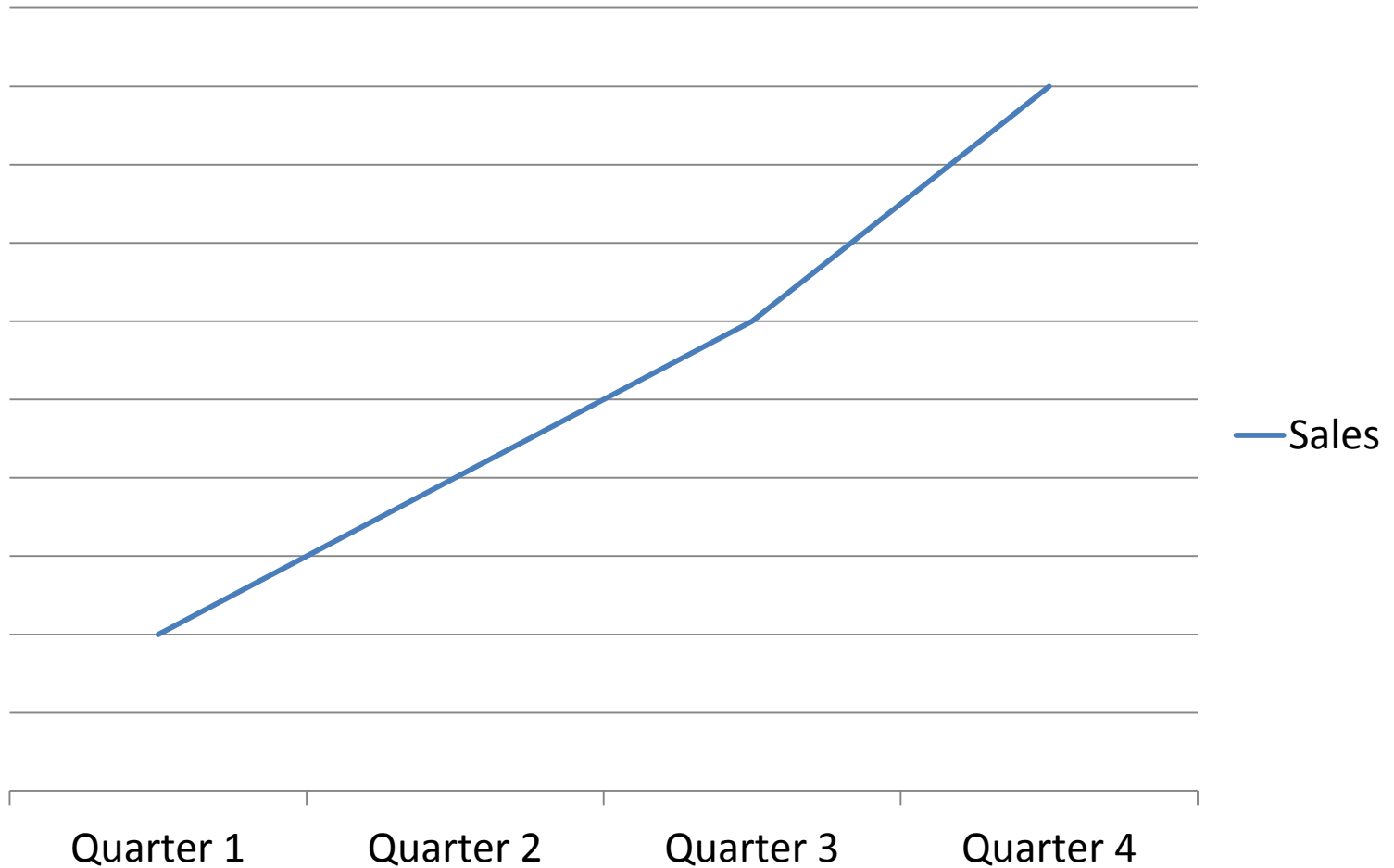
THE DOCTORS' CHOICE IS AMERICA'S CHOICE!

For 30 days, test Camels in your "B-Zone" (B for Breathe, T for Taste).



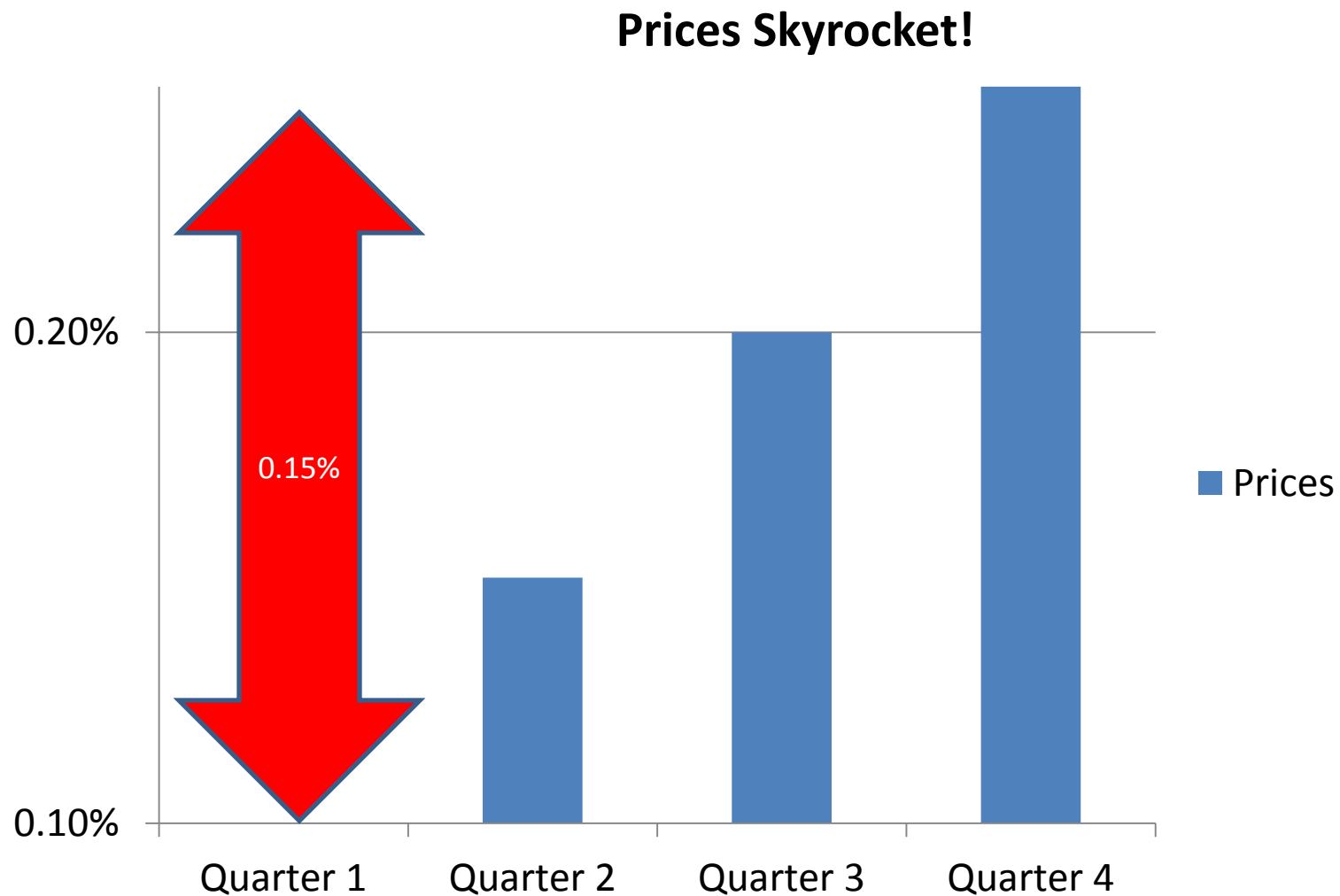
Missing Information-Graphics Version

Sales Skyrocket!



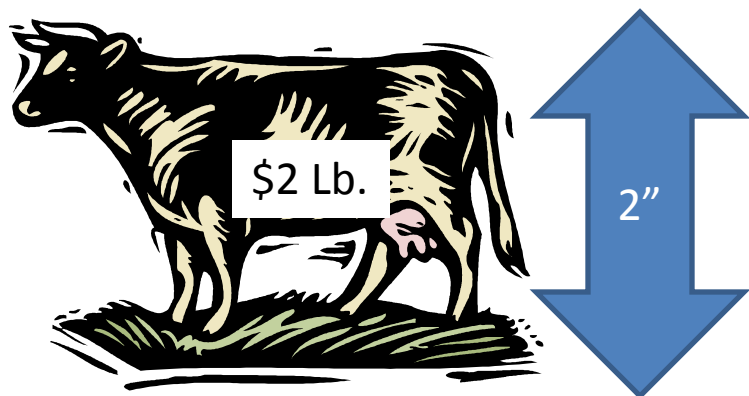


Scale Distortion

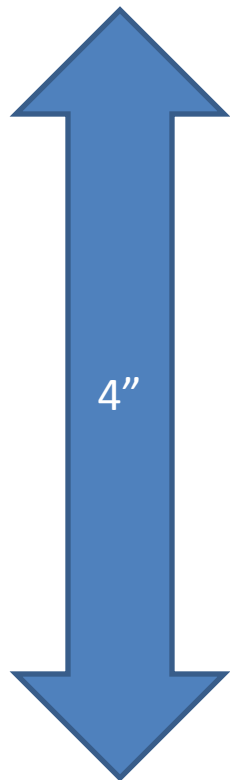




3D Trickery



Beef Prices Double!
(But appear to quadruple)





“Say-What” and “So-What” Statistics

- The say-what? statistic
 - “Lean organizations are 20% more efficient!”
 - More efficient than ... ?
- The so-what statistic
 - “More Black Belts prefer Puffs facial tissue”
 - Who cares? Black Belts are no more qualified than anyone else to make this assessment.



Lurking Variables Can Make a Difference

Gender Bias in School Admissions!

Sex	Accept	Reject	Total	Rate
Male	700	300	1000	70%
Female	400	600	1000	40%
Total	1100	900	2000	55%

Tough Program's Admission Data

Sex	Accept	Reject	Total	Rate
Male	40	160	200	20%
Female	200	600	800	25%
Total	240	760	1000	24%

Easy Program's Admission Data

Sex	Accept	Reject	Total	Rate
Male	660	140	800	83%
Female	200	0	200	100%
Total	860	140	1000	86%

Simpson's Paradox



True But Misleading Risk Statements

- Let's assume the following is true:
 - For every 100,000 people who *don't* drink Yippee soda 99,999 will survive for the next year.
 - For every 100,000 Yippee soda drinkers 99,998 will survive for the next year.
- True statement
 - **“Drinking Yippee Doubles your risk of dying”**
- Medical researchers report the “relative risk”
 - Risk for non-Yippee drinkers: 1/100,000.
 - Risk for Yippee drinkers: 2/100,000
 - Relative Risk: **2**



Risk Reporting Example

MailOnline



Home U.K. Home News Sport U.S. Showbiz Femail **Health** Science Money RightM

Health Home | Health Directory | Health Boards | Diets | MyDish Recipe Finder

AdChoices ▶
Email Marketing for
your small business.



Taking painkillers long-term 'triples risk of kidney cancer'

By CLAIRE BATES

Last updated at 10:52 AM on 13th September 2011

Comments (16) | Share +1 0 | Tweet 11 | Like 140



The overall risk of renal cell cancer remains small in comparison to that of other major diseases.

Only six per 100,000 people are expected to develop the condition

Odds of **not** getting renal cell cancer:

No Painkillers: 99,998 in 100,000

Painkillers: 99,992 in 100,000



From a Scientist Who Studies Research



BRAVE THINKERS | NOVEMBER 2010 ATLANTIC MAGAZINE

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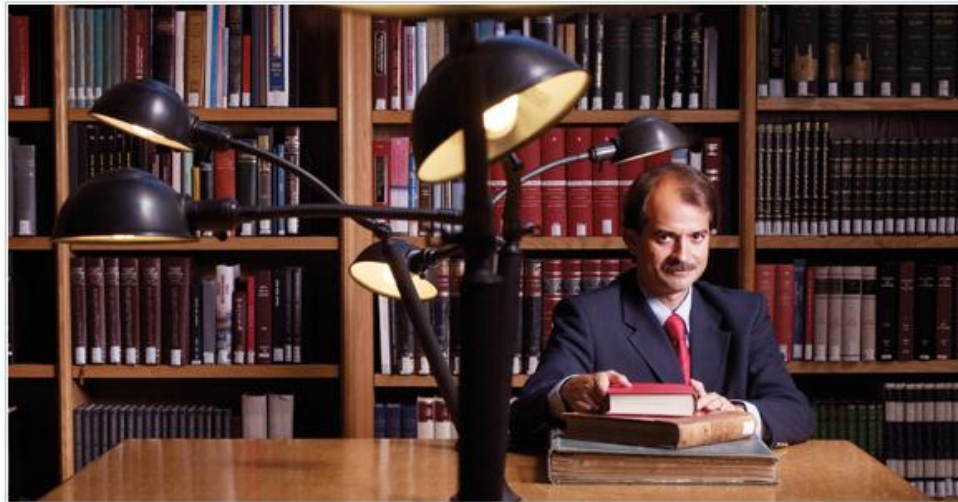
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Lies, Damned Lies, and Medical Science

Much of what medical researchers conclude in their studies is misleading, exaggerated, or flat-out wrong. So why are doctors—to a striking extent—still drawing upon misinformation in their everyday practice? Dr. John Ioannidis has spent his career challenging his peers by exposing their bad science.

By DAVID H. FREEDMAN

 20  Recommend 17k



Robyn Twomey/Radux



Example of Problems

Melton Times

News Sport Lifestyle Community

Tuesday 6 December 2011

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Heart risk of painkillers examined Sponsored

Published on Tuesday 6 December 2011 00:04

A painkiller taken by millions can increase the risk of heart attack and stroke by 40%, the Daily Mail has today reported. The newspaper says that researchers are calling for the drug, called diclofenac, to be available on prescription only.

The news is based on a large review that looked at the cardiovascular risks associated with a class of widely used painkillers called non-steroidal anti-inflammatory drugs (NSAIDs). NSAIDs in high-dose formulations are usually only available on prescription, but some low-dose NSAIDs, including ibuprofen, naproxen and diclofenac, can be bought over the counter.

Where did the story come from?

The study was carried out by researchers affiliated with Hull York Medical School, the Institute for Clinical Evaluative Sciences, the University of Toronto in Canada and the University of Newcastle in Australia. It received no external funding. The study was published in the peer-reviewed journal PLoS Medicine.



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Why Most Published Research Findings Are False

Article Metrics Related Content Comments: 26

John P. A. Ioannidis

Abstract [Top](#)

Summary

There is increasing concern that most current published research findings are false. The probability that a research claim is true may depend on study power and bias, the number of other studies on the same question, and, importantly, the ratio of true to no relationships among the relationships probed in each scientific field. In this framework, a research finding is less likely to be true when the studies conducted in a field are smaller; when effect sizes are smaller; when there is a greater number and lesser preselection of tested relationships; where there is greater flexibility in designs.

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Other Issues

As its authors point out, it had some limitations.

It had to rely on observational studies (rather than randomised controlled trials), which are subject to bias, especially in terms of other factors (**confounders**) that might influence results. However, the researchers did take steps to minimise this risk.

The data in the studies mainly came from large administrative databases and electronic health records, and may not have been comprehensive, especially concerning key information such as use of non-prescription NSAIDs and aspirin, or information about people's risk of heart problems.

The review suffered from 'heterogeneity'. This means that many of the studies varied in their design, their methods and how they analysed results. Heterogeneity makes it harder to combine the results of different studies accurately and can, therefore, throw doubt on the findings of systematic reviews.

Source Studies had Weak designs to begin with

Lurking Variables

Confounders

Mixed apples and oranges



Questions?

Be careful! Don't let this happen to you!