

Most Research Findings Might be False, But Some Are Still Worth Doing

Han Zhuang
hzhuang@syr.edu

Daniel Acuna
deacuna@syr.edu



Introduction

- Published research findings have the transformative potential to influence policies and many aspects of society.
- However, researchers have shown that under a broad set of reasonable statistical assumptions, most published research findings are likely false [1].
- Further, recent replication studies have empirically supported this conclusion [2].
- Some researchers have suggested solutions to this apparent paradox by making the statistical decisions more stringent (e.g., smaller p-value thresholds [3]).

Research Question

- Is there published research that is likely false but still worth doing?

Research Design

Cost Estimation:
Collect Cost on Brain, Breast, Liver, Lung and Ovarian Cancer Research in NIH

Benefit Estimation:

Step 1: Collect Mortality-Incidence Rate of Different Cancers from 1999 to 2015

Step 2: Calculate the Average Reduction of Mortality-Incidence Rate (ARMIR) for Different Cancers

Step 3: Benefit = ARMIR × Age-Adjusted Incidence Rate × Population × Value of Life

Positive Predictive Value of Research:

$$PPV = \frac{[1 - \beta]R + \mu\beta R}{(R + \alpha - \beta R + \mu\alpha + \mu\beta R)}$$

R is the pre-study odds of True Relationship and False Relationship
α is type I error, β is type II error and μ is bias in research

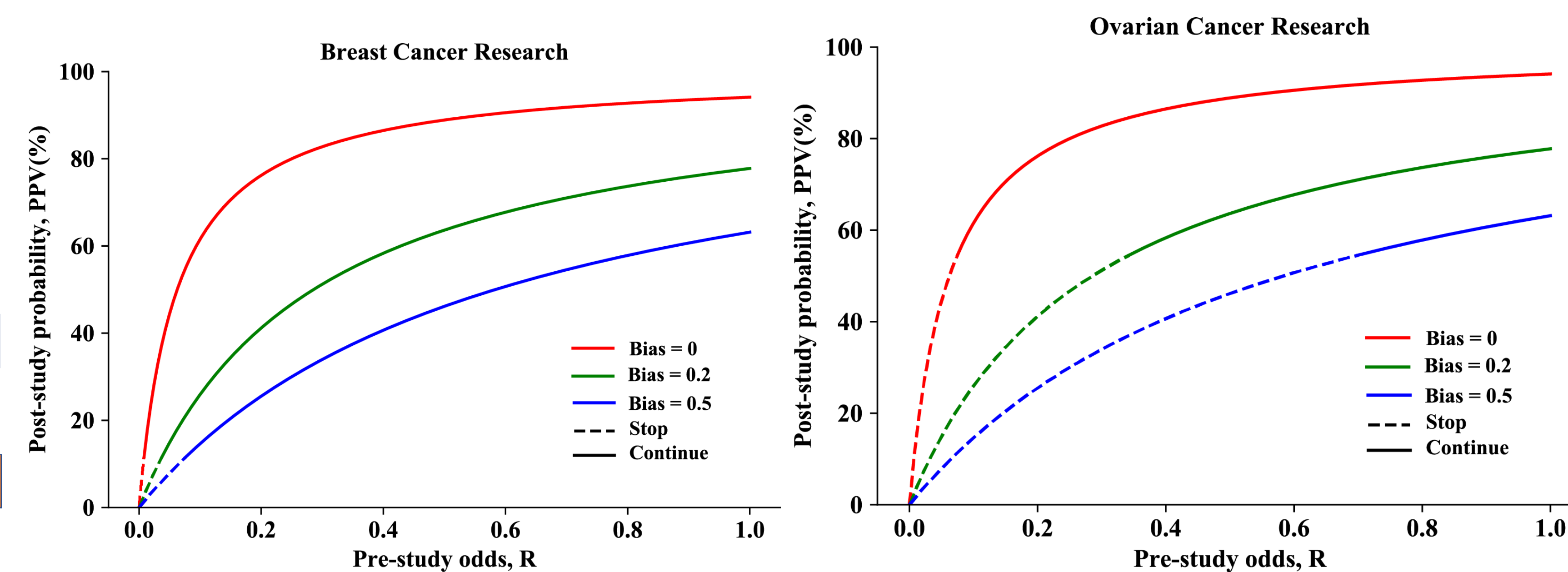
Cost and Benefit Analysis:

Cost of Doing Research = Cost + (1 - PPV) × (Benefit)

Cost of Stop Research = Benefit

Decision Function = Cost of Doing Research - Cost of Stop Research

Findings



Above two figures are illustrations of how the sign (positive or negative) of the outcome from decision function changes over pre-study odds in breast cancer research and ovarian cancer research.

Cancer Types	The Change of Mortality-Incidence Rate	Cost (\$B)	Benefit (\$B)	Pre-Study Odds for Positive Return
Breast	-0.28%	0.67	5.85	0.8%
Liver	-1.11%	0.085	2.42	0.2%
Lung	-0.53%	0.35	9.32	0.24%
Ovary	-0.0637%	0.118	0.22	7.2%

Cost and Benefit Analysis of Cancer Research: the required pre-study odds for positive return shows that even though some research findings are more likely to be false, they are still worth doing, after considered the cost and benefit of research.

Conclusion

- Research on some cancers benefit society by decreasing the mortality incidence rate of these diseases.
- The benefit of cancer research is not just about reducing mortality-incidence rate, but it is also about how to improve the well-being of patients.
- Therefore, we argue that if the benefit of research is high, then those research should be conducted carefully.
- Also, we indeed found that there are some instances of research (such as breast and ovarian cancer) that are worthy of doing even if the research findings are more likely to be false (pre-study odds < 1).