



*The RgC Annual Meeting
2022, UMCG, Groningen
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Causal Inference

Illustrated via Simpson's paradox

Ofer Engel



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Sex Bias in Graduate Admissions: Data from Berkeley

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Abstract

Examination of aggregate data on graduate admissions to the University of California, Berkeley, for fall 1973 shows a clear but misleading pattern of bias against female applicants. Examination of the disaggregated data reveals few decision-making units that show statistically significant departures from expected frequencies of female admissions, and about as many units appear to favor women as to favor men. If the data are properly pooled

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Department	Men			Women		
	Applicants	Admitted		Applicants	Admitted	
A	825	512.00	62%	108	89	82%
B	560	353	63%	25	17	68%
C	325	108	33%	593	202	34%
D	417	138	33%	375	131	35%
E	191	48	25%	393	98	25%
F	373	22	6%	341	24	7%
SUM	2691	1181	43.9%	1835	561	30.6%

Selective departments

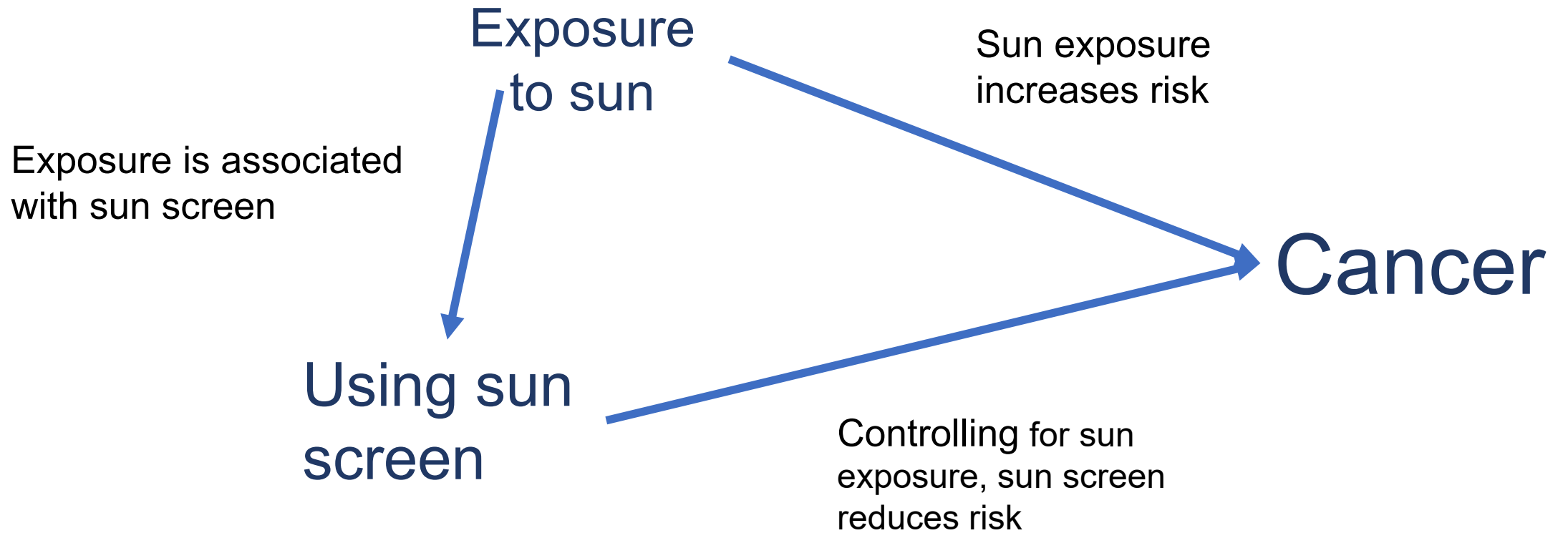
Women apply to more selective departments

Gender

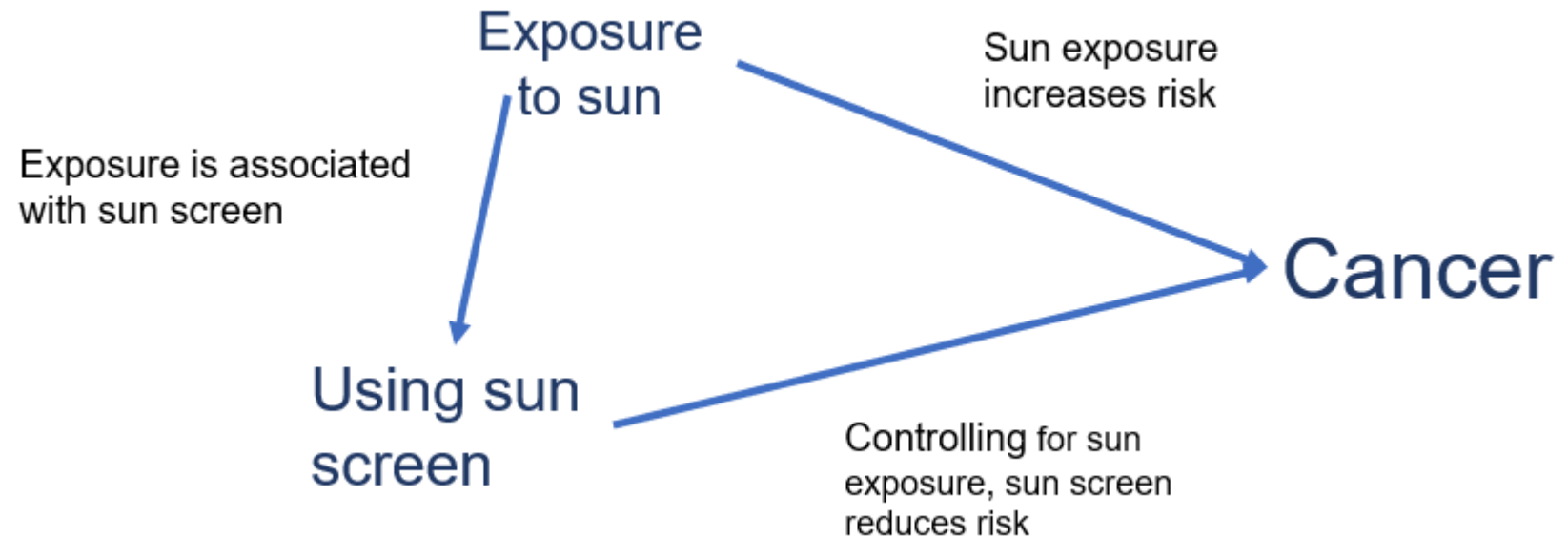
Applying to more selective departments makes it less likely to get admitted

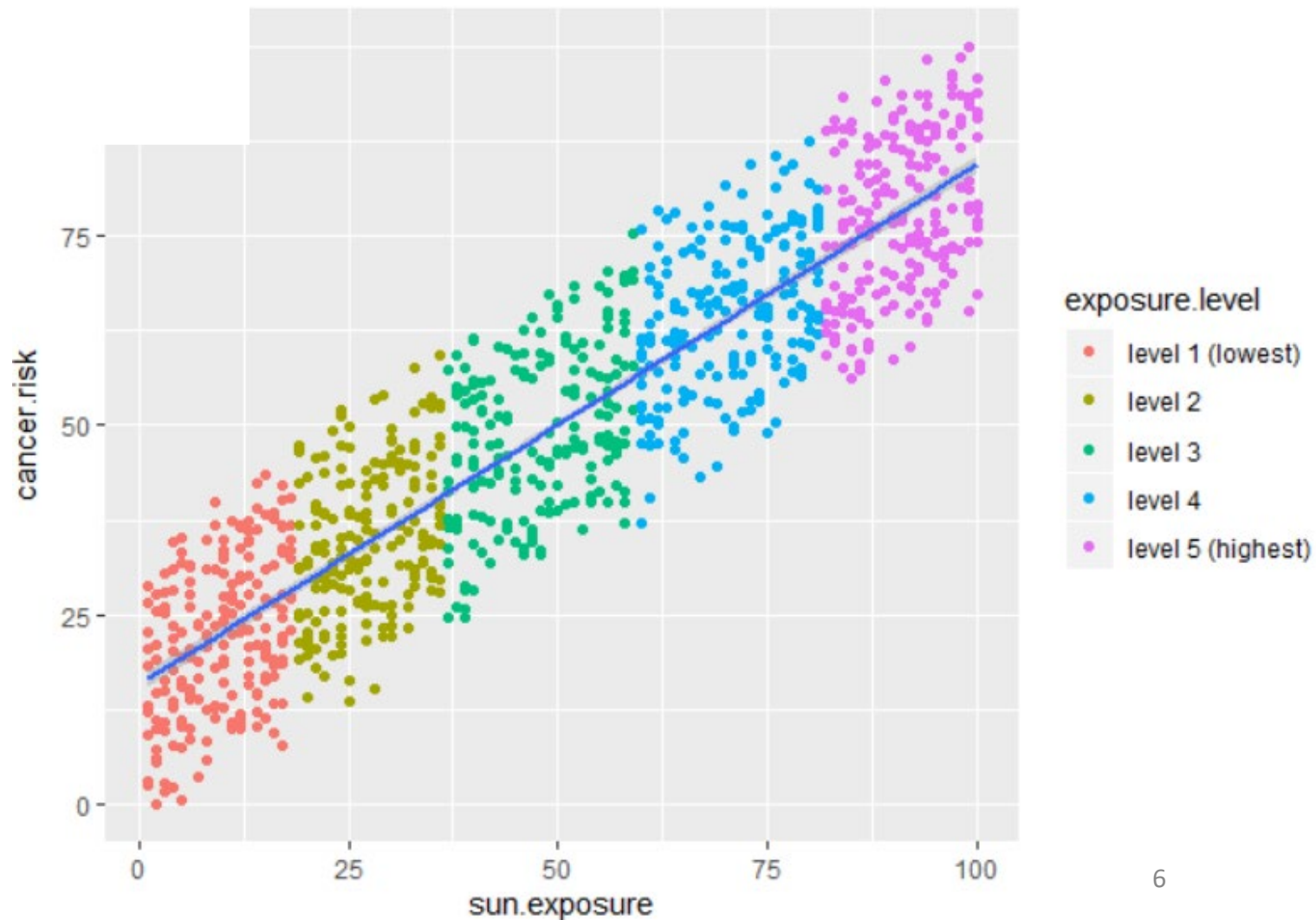
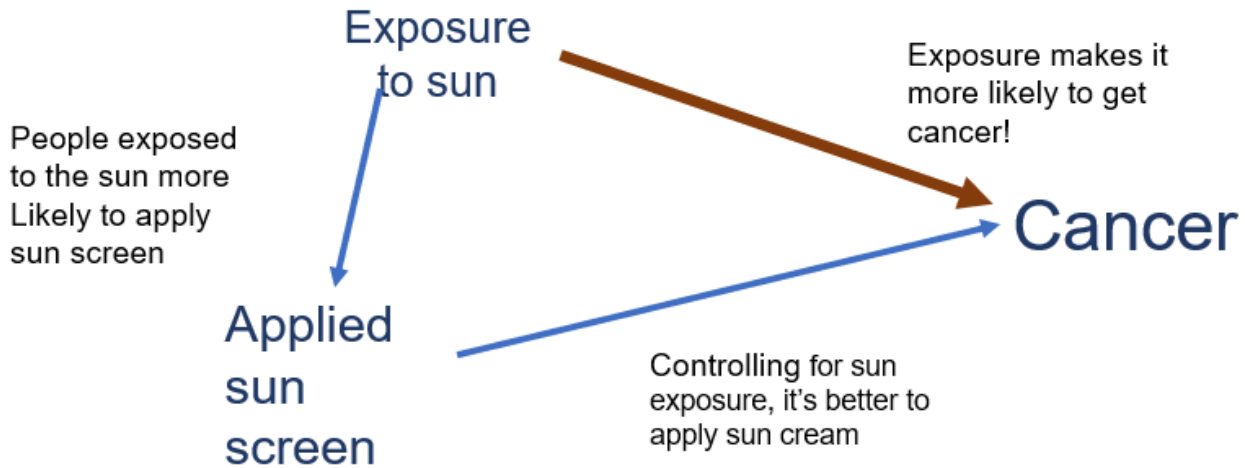
Admitted

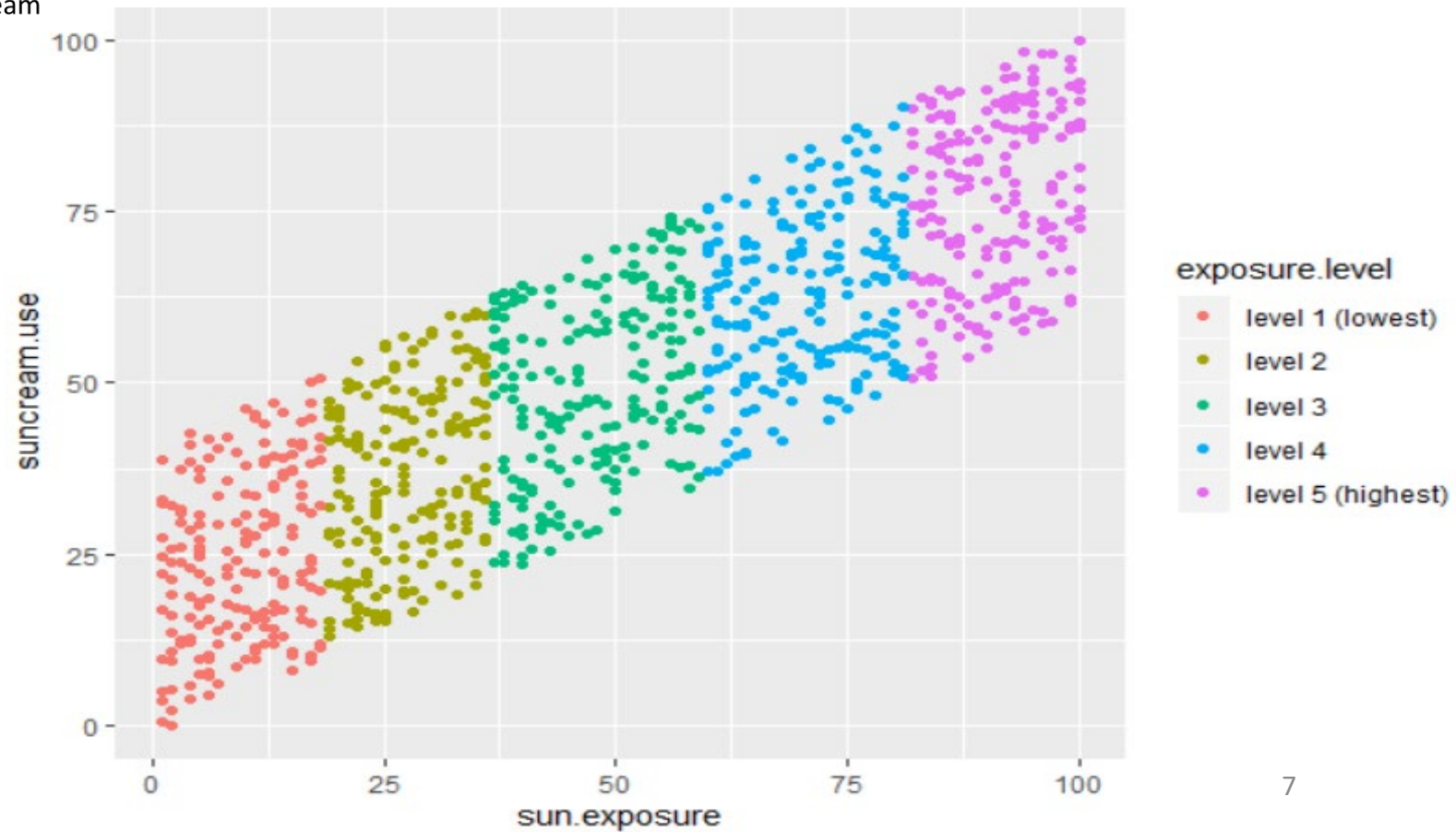
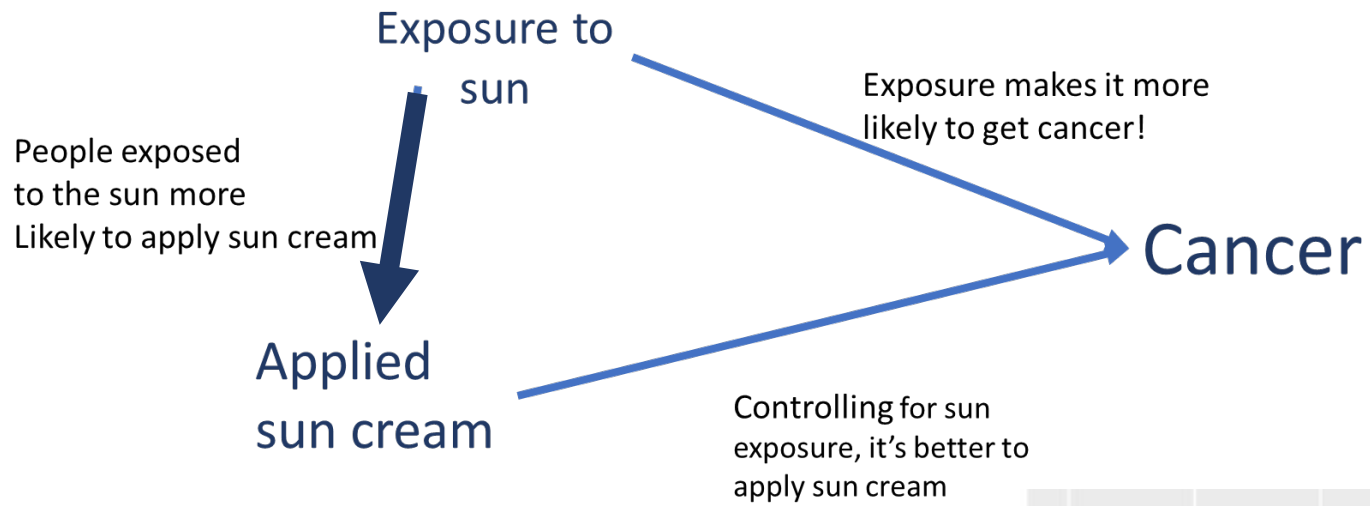
Controlling for the department, no evidence for gender discrimination in Berkeley's admission process, 1973

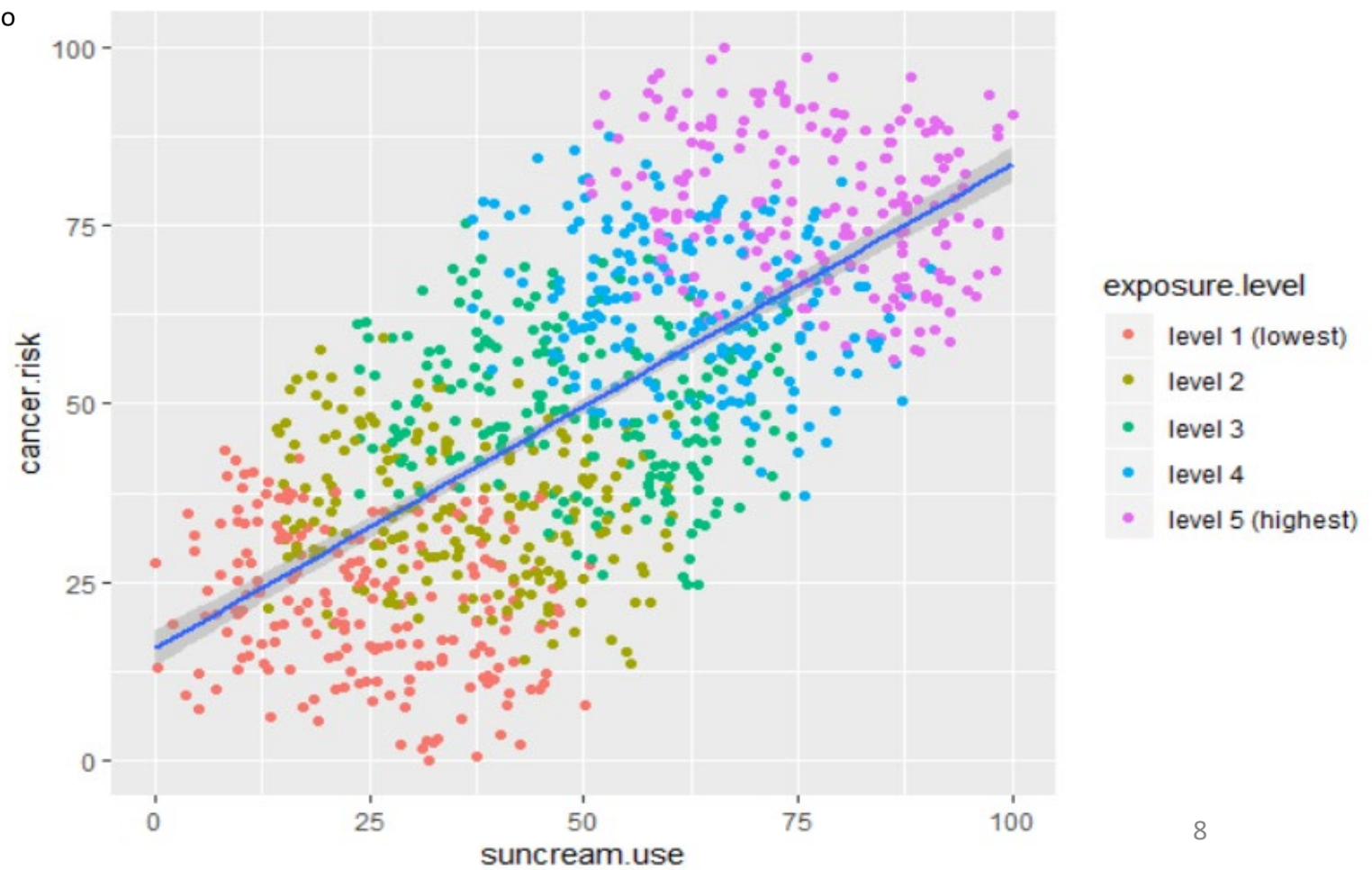
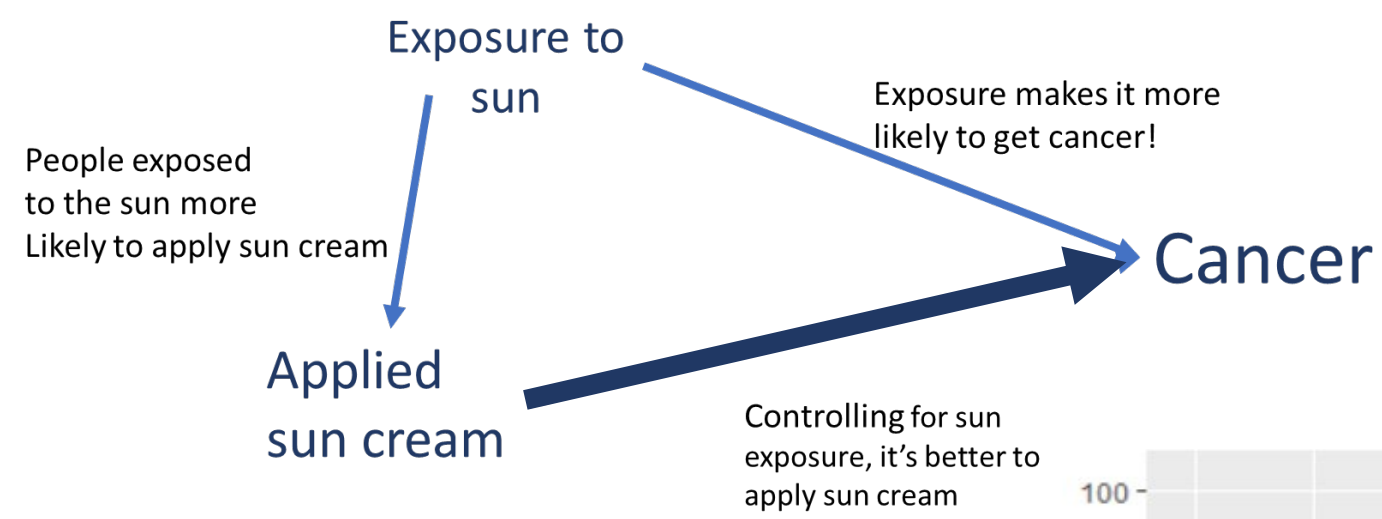


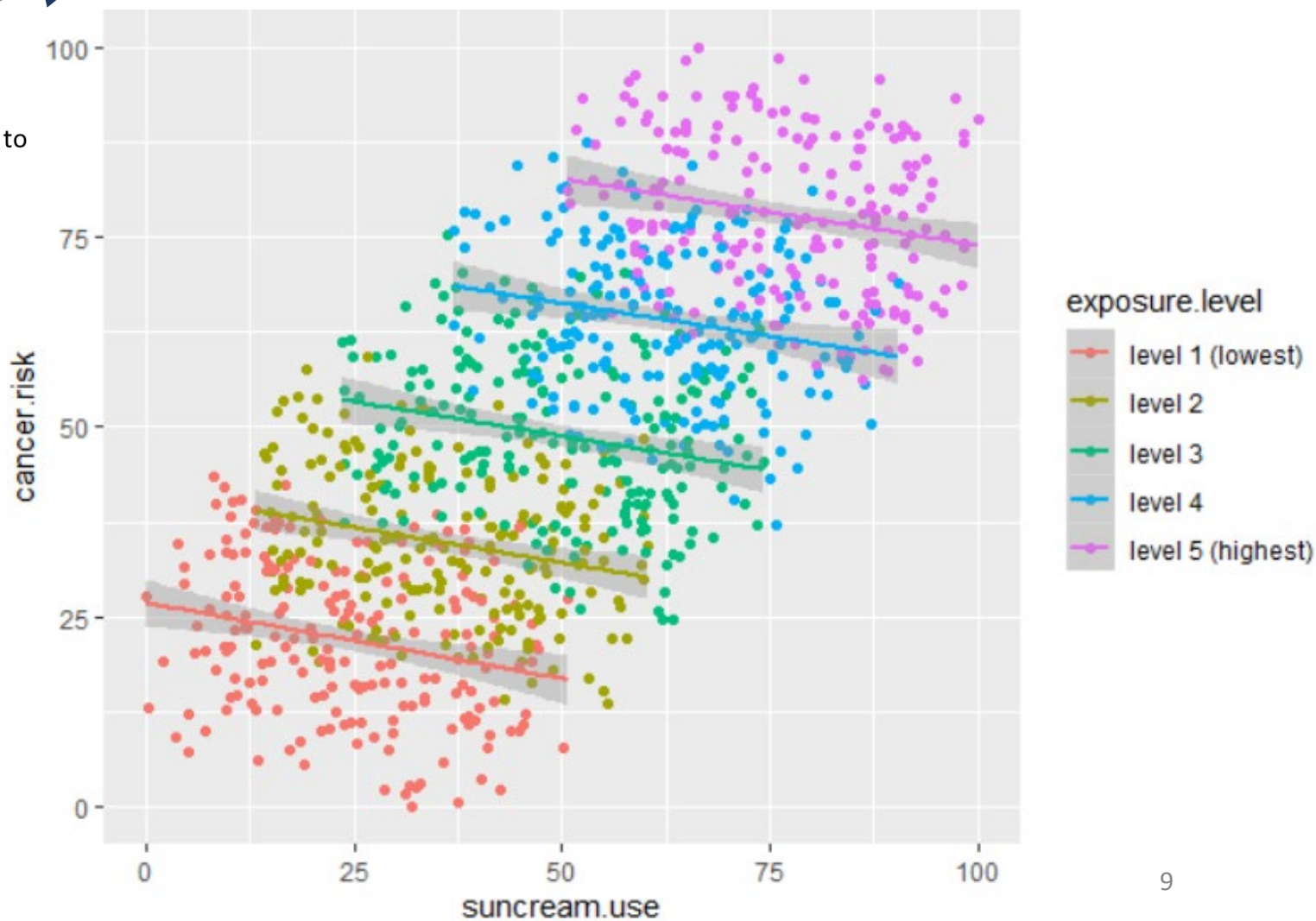
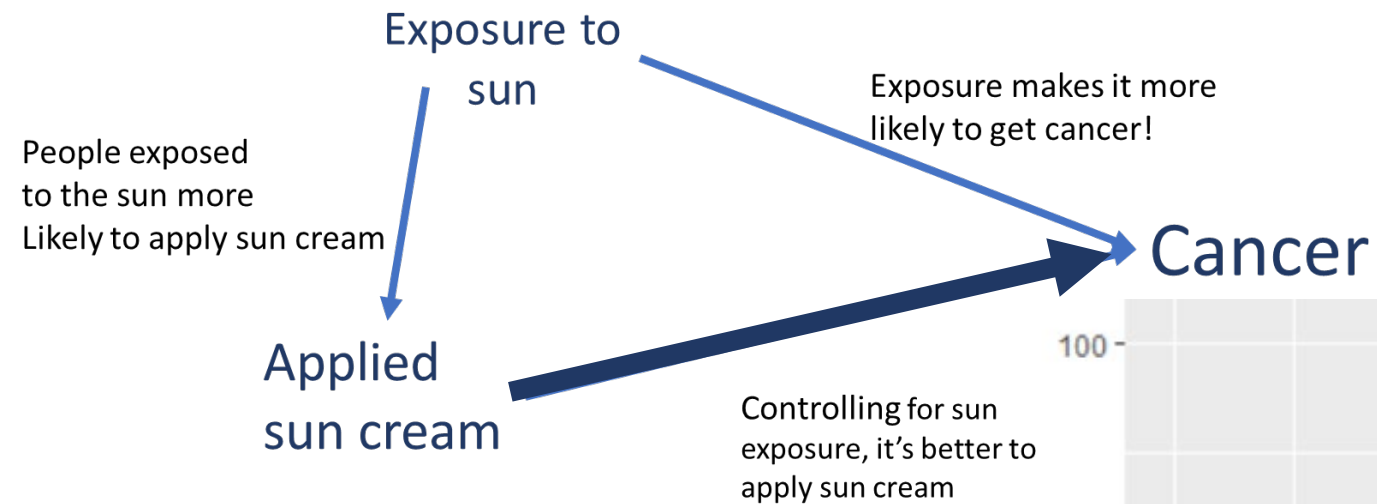
Exposure to the Sun	Did apply sun screen			Did not apply sun screen		
	Cancer	No cancer	% of patients with cancer	Cancer	No cancer	% of patients with cancer
a little	1	19	5.0%	3	37	7.5%
A LOT	12	28	30.0%	8	12	40.0%
Total	13	47	21.7%	11	49	18.3%









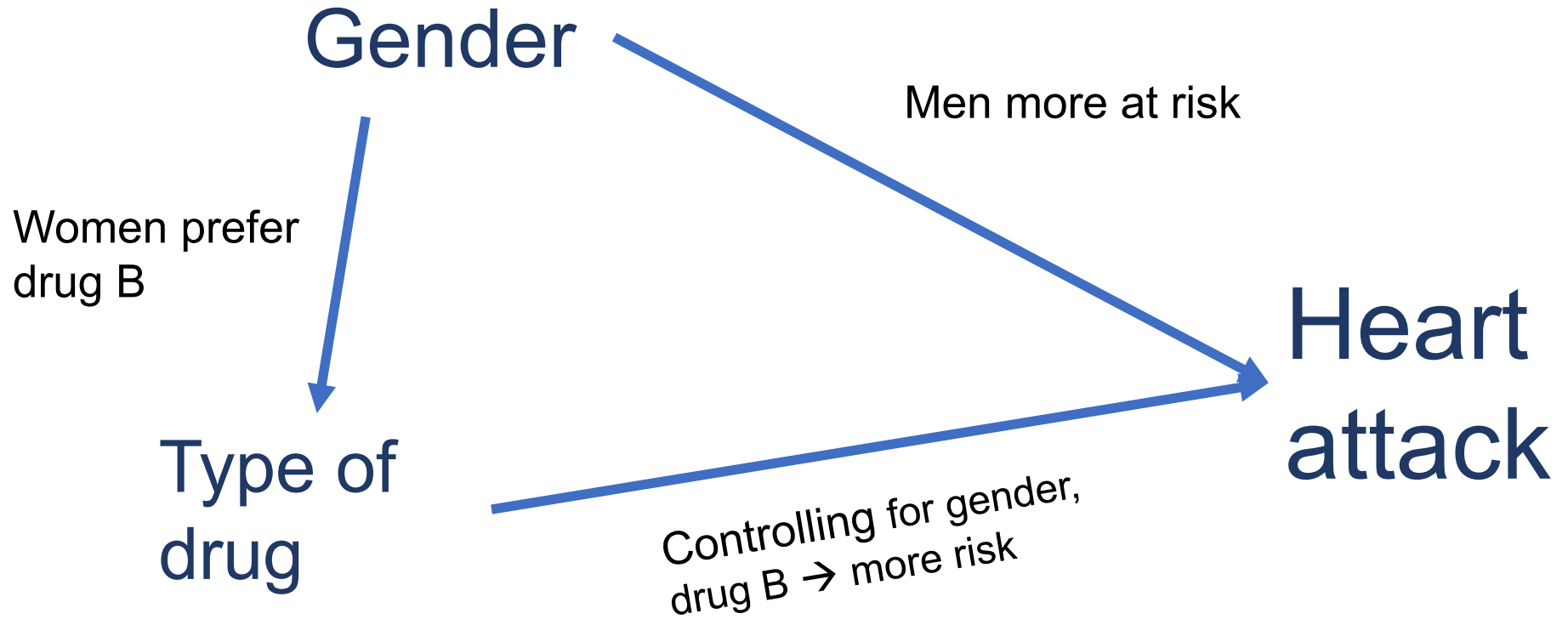


	Drug A			Drug B		
	Heart attack	No heart attack	% of patients with heart attacks	Heart attack	No heart attack	% of patients with heart attacks
Female	1	19	5.0%	3	37	7.5%
Male	12	28	30.0%	8	12	40.0%
Total	13	47	21.7%	11	49	18.3%

Two drugs are tested on patients with a heart condition. The table shows the results of an experiment on a perfectly representative sample of patients. Which is correct (more than one)?

- A. Males are less at risk when taking drug A (rather than B)
- B. Females are less at risk when taking drug B (rather than A)
- C. Overall, patients are less at risk when taking drug A (rather than B)
- D. Overall, patients are less at risk when taking drug B (rather than A)

	Drug A			Drug B		
	Heart attack	No heart attack	% of patients with heart attacks	Heart attack	No heart attack	% of patients with heart attacks
Female	1	19	5.0%	3	37	7.5%
Male	12	28	30.0%	8	12	40.0%
Total	13	47	21.7%	11	49	18.3%

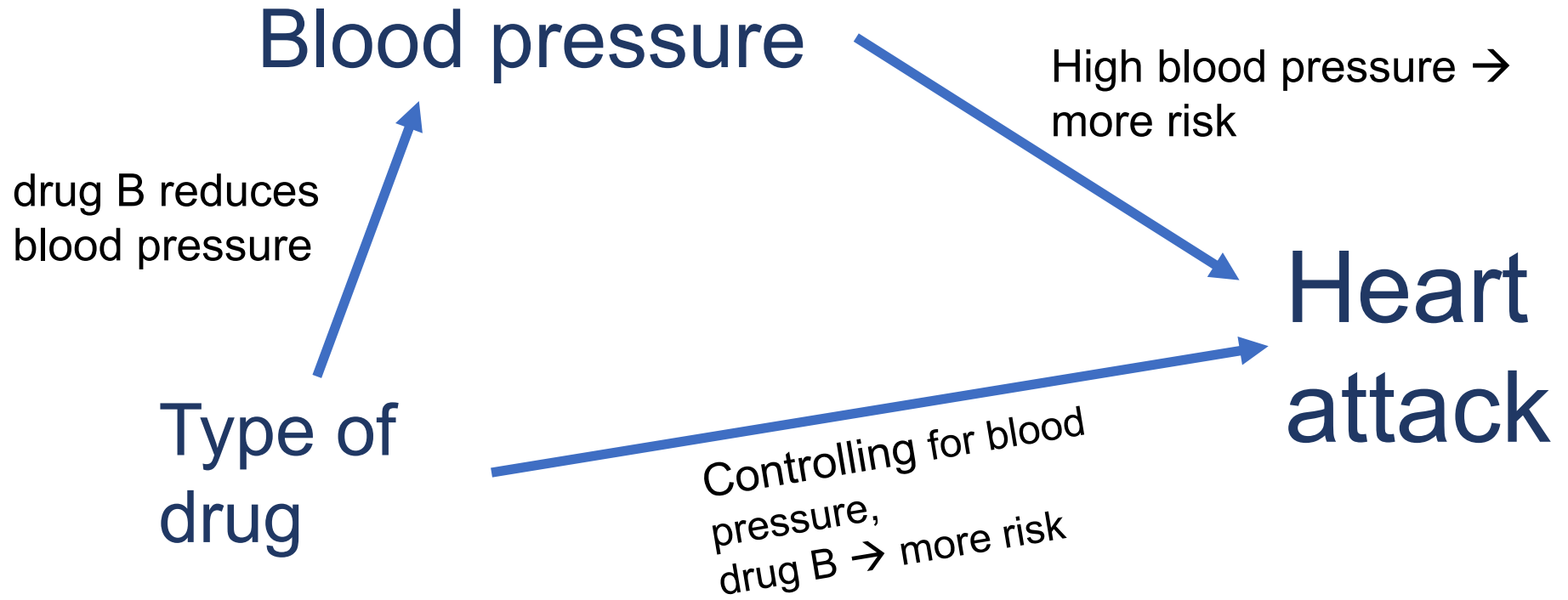


	Drug A			Drug B		
	Heart attack	No heart attack	% of patients with heart attacks	Heart attack	No heart attack	% of patients with heart attacks
Low blood pressure	1	19	5.0%	3	37	7.5%
High blood pressure	12	28	30.0%	8	12	40.0%
Total	13	47	21.7%	11	49	18.3%

Two drugs are tested on patients with a heart condition. The table shows the results of an experiment on a perfectly representative sample of patients. Which is correct (more than one)?

- A. Drug A is associated with lower blood pressure than B
- B. Drug B is associated with lower blood pressure than A
- C. Overall, patients are less at risk when taking drug A (rather than B)
- D. Overall, patients are less at risk when taking drug B (rather than A)

	Drug A			Drug B		
	Heart attack	No heart attack	% of patients with heart attacks	Heart attack	No heart attack	% of patients with heart attacks
Low blood pressure	1	19	5.0%	3	37	7.5%
High blood pressure	12	28	30.0%	8	12	40.0%
Total	13	47	21.7%	11	49	18.3%

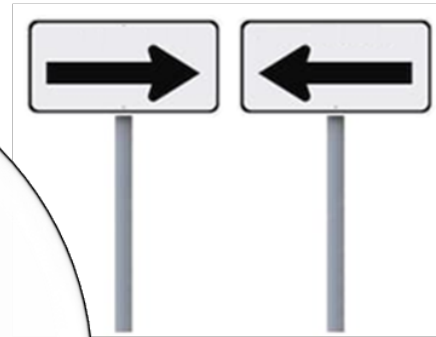


Simpson's Paradox:
a trend observed in a population
disappears when partitioned
to subgroups

OR even reverses



Simpson's Paradox



Opposing
forces

Causality

Whole-
Part

