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Statistics in Evidence Based Medicine (2014)

Lecture 2: Marginal and Conditional Odds Ratios

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Course outline

Understanding logistic regression in five lectures

Difference between relative risk and odds ratio ✓, marginal and conditional odds ratios, terminology and interpretation of logistic regression, matched data analysis

Suggested Book: Logistic Regression A Self-Learning Text by Kleinbaum & Klein

Third Edition Springer

Today's lecture

- Marginal Odds Ratios and Conditional Odds Ratios
- Confounding and Effect Modification
- Examples
- Interpretation and appropriate use

Example of a dataset

A	B	C	n
1	1	1	5
1	1	0	15
1	0	1	8
1	0	0	12
0	1	1	3
0	1	0	3
0	0	1	4
0	0	0	2
			52

Ignoring variable C

	B=1	B=0
A=1	20	20
A=0	6	6

Marginal Odds Ratio

$$OR_{AB}=\frac{20\times6}{20\times6}=1$$

Conditioning on C variable

C = 1

	B=1	B=0
A=1	5	8
A=0	3	4

$$OR_{AB/C=1} = 20/24 = 5/6$$

C = 0

	B=1	B=0
A=1	15	12
A=0	3	2

$$OR_{AB/C=0} = 30/36 = 5/6$$

Example of another dataset

E	D	C	n
1	1	1	364
1	1	0	966
1	0	1	3872
1	0	0	3146
0	1	1	348
0	1	0	3000
0	0	1	2400
0	0	0	3000
			15546

Ignoring variable C

	D=1	D=0
E=1	1330	7018
E=0	798	6400

Marginal Odds Ratio

$$OR_{ED}=\frac{1330\times6400}{7018\times798}\approx1.5$$

Conditioning on C variable

C = 1

	D=1	D=0
E=1	364	3872
E=0	348	3400

$OR_{ED/C=1} \approx 0.92$

C = 0

	D=1	D=0
E=1	968	3146
E=0	450	3000

$OR_{ED/C=0} \approx 2.1$

Important facts

- Marginal and conditional odds ratios are two different concepts
- Marginal and conditional odds ratios can be similar or different
- Conditional odds ratios at different levels of a variable can be similar to one another and marginal odds ratio can be very different

Confounding

- Means mixing
- Distortion (an error) of an association between two variables (exposure and outcome) due to a third factor
- May cause an overestimate of strength of relationship or vise versa
- May be responsible for all or partial relationship
- Can be controlled in study design and in analysis

Three conditions of confounding

1. Confounding factor must be associated with both risk factor and outcome
2. Confounding factor must be distributed unequally among the groups being compared
3. A confounder can’t be an intermediary step between the risk factor and the outcome

Example of confounding

- Want to evaluate casual association between physical inactivity and coronary heart disease

?

Physical inactivity  Heart disease

Is age a confounding factor?

Check for confounding

- Confounding factor must be associated with both risk factor and outcome✓

  Age is both related to physical inactivity and heart disease

- Confounding factor must be distributed unequally among the groups being compared ✓

  Young people are more active than older folks!

- A confounder can't be an intermediary step between the risk factor and the outcome ✓

  Being inactive does not lead to increased age which increases the risk of heart disease

Age as confounding factor

Age < 50, Age=C = 0

	D=Heart Disease=1	D=No Heart Disease=0
E=Inactive=1	10	90
E=Active=0	35	465

$OR_{ED/C=0} = 1.48$

Age > 50, Age C = 1

	Heart Disease=1	Heart Disease=0
E=Inactive=1	36	164
E=Active=0	25	175

$OR_{ED/C=1} = 1.54$

Checking for confounding factor

- Marginal odds ratio ignoring age=1.93
- Conditional odds ratios 1.48 and 1.54
- Conditional odds ratios are similar but not equal, different from marginal odds ratio
- Percent differences of conditional odds ratios

  (1.93-1.54)/1.93=**0.2**, (1.93-1.48)/1.93**=0.23**
- When the percent differences between marginal and conditional odds ratios are more than 10%, confounding is present

Statistical adjustment for confounding

Statistical techniques allow for computation of an adjusted or common odds ratio. This adjusted odds ratio is different from marginal odds ratio and takes confounding into account.

Adjusted Odds Ratio=1.52

Cochran Mantel Haenszel estimate

Effect Modification (Interaction)

- Effect of the magnitude of the primary exposure variable on the outcome is different at different levels of a third variable
- Distinct from confounding
- Confounding can be adjusted in statistical analysis but a common odds ratio can't be reported for effect modification; have to examine the relationship at each level of effect modifier

Examples

- In a clinical trial a drug is statistically effective for reducing total cholesterol but when analyzed for a specific genetic marker, only effective in people with marker present, no effect for people with absent genetic marker
- Exposure: treatment with aspirin during a viral illness, Outcome: Reye's syndrome, Effect modifier: age

  different effect for children and adults, increases the risk of Reye's syndrome in children, no effect on outcome for adults

Example: Age as effect modifier

A=Age < 60=0

	H=Heart Attack	H=No Heart Attack
B=High BP	9	115
B=Normal	6	73

$OR_{BH/A=0} = 0.95$

A=Age > 60=1

	H=Heart Attack	H=No Heart Attack
B=High BP	20	596
B=Normal	21	1171

$OR_{BH/C=1} = 1.87$

Example: Age as an effect modifier

- Here the marginal odds ratio=1.88
- Conditional odds ratios 0.95 and 1.87
- This is the example of only interaction or effect modification.
- **Conditional odds ratios differ significantly from one another**

When there is only confounding

- Conditional odds ratios will be similar to one another but different from marginal odds ratio.
- Percent difference will be more than 10%
- Can use statistical methods to get a pooled odds ratio

Other situations

- **Neither confounding nor interaction**
  - Estimates of conditional odds ratios and marginal odds ratios will be similar
- **Both confounding and interaction**
  - Conditional odds ratios differ from one another; both either less than marginal odds ratio or greater than marginal odds ratio

References

- Boston University school of public health online module

http://sphweb.bumc.bu.edu/otlt/MPH-Modules/BS/BS704-EP713_Confounding-EM/

- Confounding, Effect Modification and Bias

Lesley Rushton

http://ieh.cranfield.ac.uk/ighrc/Presentations/Intro%20epidemiological/confounding%20effect.pdf

- The Simpson's paradox unraveled

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http://ije.oxfordjournals.org/content/early/2011/03/30/ije.dyr041.full

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Questions/Comments

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Thank you for being patient !