

On the use of robust Poisson regression to correct bias and precision of the odds ratio estimated using polytomic logistic regression as an approximation of the relative risk

Vânia Naomi Hirakata

Suzi Alves Camey

Álvaro Vigo

Introduction

- Problem
 - Overestimation of RR by OR
 - Polytomic outcome
 - Logistic polytomous regression

Objective

- To present the use of the robust Poisson regression model as an alternative to correct bias and precision of odds ratio estimated by polytomic logistic regression as an approximation of the relative risk.

Methods

- Database:
 - ECCAGe Study: retrospective longitudinal
 - Outcome: pregnant weight gain
 - » Insufficient
 - » Adequate
 - » Excessive

Methods

- Database:
 - Independent variables:
 - body mass index (BMI) at the start of pregnancy
 - ✓ < 19.8
 - ✓ $19.8 \text{ |-- } 26.0$
 - ✓ $26.0 \text{ |-- } 29.0$
 - ✓ ≥ 29.0
 - number of prenatal visits
 - ✓ ≤ 6 visits
 - ✓ 7 to 9 visits
 - ✓ ≥ 10 visits

Methods

- Begg and grey approach to polithomous logistic regression*:
 - Use of individualized logistic regression, in which a series of separate simple logistic regression analyses are performed in the place of a polychotomous logistic regression

* *Biometrika*, Vol. 71, No. 1. (Apr., 1984), pp. 11-18

Methods

	Pregnancy weight gain			
Exposure	Insufficient	Adequate	Excessive	TOTAL
With	a	b	c	a + b + c
Without	d	e	f	d + e + f

$$OR_{ins} = \frac{a/b}{d/e} = \frac{a \times e}{b \times d}$$

$$OR_{exc} = \frac{c/b}{f/e} = \frac{c \times e}{b \times f}$$

$$RR_{ins} = \frac{a/(a+b+c)}{d/(d+e+f)}$$

$$RR_{exc} = \frac{c/(a+b+c)}{f/(d+e+f)}$$

Methods

- Use of offset subcommand and to run 2 robust Poisson regression.
 - In this case, the offset will be the weight of each combination or, in other words, the denominator of the combination.

Methods

Recode the outcome into 2 dichotomous variable and run the robust Poisson regression 2 times:

- 1) To analyze insufficient group, recode adequate = excessive
- 2) To analyze excessive group, recode adequate = insufficient

Methods

- SPSS version 16.0
- SAS version 9.1.3

Results

	Pregnancy weight gain			Total
	insufficient	adequate	excessive	
BMI at the start of pregnancy				
< 19.8	35 (40.2%)	30 (34.5%)	22 (25.3%)	87
19.8-26	125 (30.7%)	140 (34.4%)	142 (34.9%)	407
26-29	10 (13.0%)	13 (16.9%)	54 (70.1%)	77
> 29	24 (25.0%)	5 (5.2%)	67 (69.8%)	96
Number of prenatal visits				
≤ 6 visits	88 (38.8%)	68 (30.0%)	71 (31.3%)	227
7 to 9 visits	78 (27.2%)	70 (24.4%)	139 (48.4%)	287
> 9 visits	28 (18.3%)	50 (32.7%)	75 (49.0%)	153

BMI at the start of pregnancy		Pregnancy weight gain			
		Insufficient		Excessive	
		value	P	value	P
< 19.8	OR	1.307 (0.758-2.251)	0.3352	0.723 (0.398-1.314)	0.2875
	RR1	1.310 (1.011-1.697)	0.0408	0.725 (0.517-1.016)	0.0619
	RR2	1.310 (0.976-1.759)	0.0727	0.725 (0.493-1.065)	0.1011
19.8-26		1.0		1.0	
26-29	OR	0.862 (0.365-2.034)	0.7338	4.095 (2.140-7.837)	<0.001
	RR1	0.424 (0.261-0.686)	0.0005	2.010 (1.704-2.371)	<0.001
	RR2	0.423 (0.233-0.768)	0.0047	2.010 (1.650-2.448)	<0.001
> 29	OR	5.375 (1.991-14.51)	0.0009	13.21 (5.170-33.76)	<0.001
	RR1	0.814 (0.660-1.004)	0.0540	2.004 (1.753-2.283)	<0.001
	RR2	0.814 (0.559-1.186)	0.2833	2.004 (1.659-2.412)	<0.001

OR: multinomial logistic

RR1: robust Poisson with OFFSET

RR2: robust Poisson with RECODE

Results

Pregnancy weight gain

	Pregnancy weight gain			Total
	insufficient	adequate	excessive	
BMI at the start of pregnancy				
< 19.8	35 (40.2%)	30 (34.5%)	22 (25.3%)	87
19.8-26	125 (30.7%)	140 (34.4%)	142 (34.9%)	407
26-29	10 (13.0%)	13 (16.9%)	54 (70.1%)	77
> 29	24 (25.0%)	5 (5.2%)	67 (69.8%)	96

125 (47%)	140 (53%)
10 (43%)	13 (57%)

BMI at the start of pregnancy		Pregnancy weight gain			
		Insufficient		Excessive	
		value	P	value	P
< 19.8	OR	1.307 (0.758-2.251)	0.3352	0.723 (0.398-1.314)	0.2875
	RR1	1.310 (1.011-1.697)	0.0408	0.725 (0.517-1.016)	0.0619
	RR2	1.310 (0.976-1.759)	0.0727	0.725 (0.493-1.065)	0.1011
19.8-26		1.0		1.0	
26-29	OR	0.862 (0.365-2.034)	0.7338	4.095 (2.140-7.837)	<0.001
	RR1	0.424 (0.261-0.686)	0.0005	2.010 (1.704-2.371)	<0.001
	RR2	0.423 (0.233-0.768)	0.0047	2.010 (1.650-2.448)	<0.001
> 29	OR	5.375 (1.991-14.51)	0.0009	13.21 (5.170-33.76)	<0.001
	RR1	0.814 (0.660-1.004)	0.0540	2.004 (1.753-2.283)	<0.001
	RR2	0.814 (0.559-1.186)	0.2833	2.004 (1.659-2.412)	<0.001

OR: multinomial logistic

RR1: robust Poisson with OFFSET

RR2: robust Poisson with RECODE

Results

Pregnancy weight gain

	Pregnancy weight gain			Total
	insufficient	adequate	excessive	
BMI at the start of pregnancy				
< 19.8	35 (40.2%)	30 (34.5%)	22 (25.3%)	87
19.8-26	125 (30.7%)	140 (34.4%)	142 (34.9%)	407
26-29	10 (13.0%)	13 (16.9%)	54 (70.1%)	77
> 29	24 (25.0%)	5 (5.2%)	67 (69.8%)	96

10 (43%)	13 (57%)
24 (83%)	5 (17%)

Pregnancy weight gain

BMI at the start of pregnancy	Pregnancy weight gain				
	Insufficient		Excessive		
	value	P	value	P	
< 19.8	OR	1.307 (0.758-2.251)	0.3352	0.723 (0.398-1.314)	0.2875
	RR1	1.310 (1.011-1.697)	0.0408	0.725 (0.517-1.016)	0.0619
	RR2	1.310 (0.976-1.759)	0.0727	0.725 (0.493-1.065)	0.1011
19.8-26		1.0		1.0	
26-29	OR	0.862 (0.365-2.034)	0.7338	4.095 (2.140-7.837)	<0.001
	RR1	0.424 (0.261-0.686)	0.0005	2.010 (1.704-2.371)	<0.001
	RR2	0.423 (0.233-0.768)	0.0047	2.010 (1.650-2.448)	<0.001
> 29	OR	5.375 (1.991-14.51)	0.0009	13.21 (5.170-33.76)	<0.001
	RR1	0.814 (0.660-1.004)	0.0540	2.004 (1.753-2.283)	<0.001
	RR2	0.814 (0.559-1.186)	0.2833	2.004 (1.659-2.412)	<0.001

OR: multinomial logistic

RR1: robust Poisson with OFFSET

RR2: robust Poisson with RECODE

Results: Multivariable analysis*

BMI at the start of pregnancy	Insufficient weight gain		Excessive weight gain	
	OR (IC 95%) RR (IC 95%)	P	OR (IC 95%) RR (IC 95%)	P
< 19.8 kg/m ²	1.253 (0.724 – 2.168) 1.258 (0.942 – 1.680)	0.776 0.120	0.726 (0.398 – 1.326) 0.684 (0.484 – 0.967)	0.186 0.032
19.8-26 kg/m ²	1	-	1	-
26-29 kg/m ²	0.848 (0.358 – 2.008) 0.432 (0.239 – 0.781)	0.280 0.005	4.037 (2.101 – 7.756) 1.963 (1.669 – 2.310)	0.001 < 0.001
>29 kg/m ²	5.205 (1.923 – 14.088) 0.803 (0.554 – 1.165)	0.004 0.248	13.67 (5.332 – 35.05) 2.013 (1.759 – 2.305)	<0.001 < 0.001

- Adjusted to number of prenatal visits
- Robust Poisson regression using recode

Conclusion

- Although studies are still needed regarding the consistency and efficiency of estimators, the discrepancies observed suggest that the robust Poisson model can be useful to estimate relative risk when nominal polytomous outcomes are used.
- Use of recode approach is more easy and less susceptible to error than the use of offset, although the precision of the offset approach

Conclusion

- In particular, extreme caution is recommended on the use of odds ratio estimated by multinomial logistic regression as an approximation of the relative risk.

Thank you



Vania.hirakata@gmail.com

Results: Multivariable analysis*

BMI at the start of pregnancy	Insufficient weight gain		Excessive weight gain	
	OR (IC 95%) RR (IC 95%)	P	OR (IC 95%) RR (IC 95%)	P
< 19.8 kg/m ²	1.09 (0.58 – 2.06) 1.17 (0.89 – 1.54)	0.776 0.260	0.63 (0.32 – 1.25) 0.77 (0.53 – 1.12)	0.186 0.174
19.8-26 kg/m ²	1	-	1	-
26-29 kg/m ²	0.58 (0.22 – 1.55) 0.37 (0.21 – 0.67)	0.280 0.001	3.38 (1.69 – 6.75) 2.02 (1.67 – 2.45)	0.001 < 0.001
>29 kg/m ²	4.49 (1.63 – 12.38) 0.80 (0.57 – 1.12)	0.004 0.196	10.34 (3.98 – 26.86) 1.995 (1.65 – 2.42)	<0.001 < 0.001

* Adjusted to number of prenatal visits and other variables

BMI at the start of pregnancy		Pregnancy weight gain			
		Insufficient		Excessive	
		value	P-value	value	P-value
< 19,8	OR RR ₁ RR ₂	1.307 (0.758- 2.251) 1.3099 (1.0114- 1.6965)1.309 9 (0.9755- 1.7590)	0,3352 0,0408 0,0727	0.723 (0.398- 1.314)*0.7248 (0.5170- 1.0161)0.7248 (0.4933- 1.0649)	0,2875 0,0619 0,1011
19,8-26		1.0		1.0	
26-29	OR RR1 RR2	0.862 (0.365- 2.034)0.42	0,7338 0,0005 0,0017	4.095 (2.140- 7.837)2.01	< 0,0001 < 0,0001 < 0,0001