

5.5 Pediatric Ulcerative Colitis Activity Index (PUCAI)

Adapted from a question by Dr. Jacob Robson (Epi 204, 2013).

When it is bad, ulcerative colitis causes frequent, bloody stools and abdominal pain. However, due to modesty (and general disgust with talking about poop), some children have trouble quantifying their symptoms sufficiently to help their clinicians to make treatment decisions. Therefore, Turner et al[1] created a Pediatric Ulcerative Colitis Activity Index (PUCAI) with specific questions about symptoms. However, it's time consuming for physicians to go through the PUCAI with children or parents. Lee et al[2] studied whether patients could reliably report the PUCAI directly to their doctors by comparing patient-completed and physician-completed PUCAI in 70 children, dividing the PUCAI into 3 disease activity groups. Results are shown in Table 2, reprinted with permission below.

TABLE 2. Comparison of the patient-completed PUCAI with the physician-completed PUCAI by disease activity groups (n = 70)

	Patient-completed PUCAI*			Kappa (95% CI)
	Inactive (n = 30)	Mild (n = 24)	Moderate/severe (n = 16)	
Physician-completed PUCAI				0.78 [†] (0.65–0.90)
Inactive (n = 36)	30 (100%)	6 (25%)	0 (0%)	
Mild (n = 20)	0 (0%)	17 (71%)	3 (19%)	
Moderate/severe (n = 14)	0 (0%)	1 (4%)	13 (81%)	

CI = confidence interval; PUCAI = Pediatric Ulcerative Colitis Activity Index.

*Percentages are based on column totals.

[†]Scale of agreement: poor (<0), slight (0.01–0.20), fair (0.21–0.40), moderate (0.41–0.60), substantial (0.61–0.80), and near perfect (0.81–0.99) (12).

Reprinted with permission from: Lee JJ, Colman RJ, Mitchell PD, Atmadja ML, Bousvaros A, Lightdale JR.

Agreement between patient- and physician-completed Pediatric Ulcerative Colitis Activity Index scores. *J Pediatr Gastroenterol Nutr.* 2011;52(6):708-13.

https://journals.lww.com/jpgn/fulltext/2011/06000/Agreement_Between_Patient_and_Physician_completed.11.aspx

a.) What was the observed percent complete agreement in this study?

Answer: Complete agreement just goes along the diagonal: 30 +17+13 = 60; 60/70=85.7%.

b) What percent complete agreement would be expected from the marginals?

Answer: We'll first need to compute row and column totals. The row totals are 30, 24 and 16; column totals are 36, 20 and 14.

Expected values:

$$36/70 \times 30 = 15.4$$

$$20/70 \times 24 = 6.9$$

$$14/70 \times 16 = 3.2$$

Expected % Agreement:

$$(15.4 + 6.9 + 3.2 = 25.5) / 70 = 36.4\%$$

c.) The researchers report an unweighted Kappa statistic of 0.78. Is their calculation correct (± 0.01)?

Answer: yes.

Kappa = (Observed agreement – Expected agreement) / (1 – Expected agreement)

Kappa: $(0.857 - 0.364) / (1 - 0.364) = 0.775 \approx 0.78$

d.) Explain in words what this Kappa signifies.

Answer: Kappa is the amount of agreement beyond what would be expected from the observer's overall estimates of frequency of the different categories (the marginals). This is often termed agreement beyond that expected by chance, but as noted in the chapter it is more accurately called agreement beyond that expected from the marginals.

e.) Is the disagreement between patient- and physician-completed PUCAI scores *balanced*? Support your answer with numbers from the table and explain what this means.

Answer: The disagreement is unbalanced. Of the 10 subjects with partial disagreement, in 9 the patient rated the disease as more severe than the physician. This may be because patients were more bothered by their colitis than the doctors realized, perhaps because there were symptoms they were too embarrassed to share when their doctor was completing the PUCAI.

f.) The researchers are disappointed that, based on their Kappa, their agreement is only "substantial." They feel like they deserve half credit when ratings are off by one category, such as when the MD classifies the disease as inactive and the patient classifies it as mild. Calculate a weighted Kappa using that weighting scheme.

Answer: This is just linear-weighted Kappa.

Weighted observed complete agreement: $60 \times 1 = 60$

Weighted observed partial agreement $(6 + 3 + 1 = 10) \times 0.5 = 5$

Total weighted observed *proportion* agreement: $(60 + 5) / 70 = 92.9\%$

Weighted expected complete agreement: 25.5 (from part b) $\times 1 = 25.5$

Weighted expected partial agreement: $0.5 \times (20 \times 30 + 24 \times 14 + 24 \times 36 + 16 \times 20) = 0.5 \times 30.28 = 15.4$

Total weighted expected *proportion* agreement = $(25.5 + 15.14) / 70 = 58\%$

Linear Weighted Kappa:

$(92.9\% - 58\%) / (100\% - 58\%) = 0.83$. Their Kappa is now "near perfect" according to their table legend.

To use Stata you can enter the data using the data editor and labeling the variables, so they look like this:

	MD	PT	freq
1.	Inactive	Inactive	30
2.	Inactive	Mild	6
3.	Inactive	Mod/severe	0

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4.      Mild      Inactive      0
5.      Mild              Mild      17
6.      Mild      Mod/severe      3
7.      Mod/severe      Inactive      0
8.      Mod/severe              Mild      1
9.      Mod/severe      Mod/severe      13

```

Then you can do:

```
. tabu md pt [fw=freq]
```

md	pt			Total
	1	2	3	
1	30	6	0	36
2	0	17	3	20
3	0	1	13	14
Total	30	24	16	70

```
. kap md pt [fw=freq] /*Unweighted Kappa*/
```

Agreement	Expected Agreement	Kappa	Std. Err.	Z	Prob>Z
85.71%	36.41%	0.7754	0.0856	9.05	0.0000

```
. kap md pt [fw=freq], w(w) /*Linear weighted Kappa*/
```

Ratings weighted by:

```

1.0000  0.5000  0.0000
0.5000  1.0000  0.5000
0.0000  0.5000  1.0000

```

Agreement	Expected Agreement	Kappa	Std. Err.	Z	Prob>Z
92.86%	58.04%	0.8298	0.0943	8.80	0.0000

```
. kap MD PT [fw=freq], w(w2) /*Quadratic weighted Kappa (FYI)*/
```

Ratings weighted by:

```

1.0000  0.7500  0.0000
0.7500  1.0000  0.7500
0.0000  0.7500  1.0000

```

Expected

Agreement	Agreement	Kappa	Std. Err.	Z	Prob>Z
96.43%	68.86%	0.8853	0.1183	7.49	0.0000

1. Turner D, Otley AR, Mack D, Hyams J, de Bruijne J, Uusoue K, et al. Development, validation, and evaluation of a pediatric ulcerative colitis activity index: a prospective multicenter study. *Gastroenterology*. 2007;133(2):423-32.
2. Lee JJ, Colman RJ, Mitchell PD, Atmadja ML, Bousvaros A, Lightdale JR. Agreement between patient- and physician-completed Pediatric Ulcerative Colitis Activity Index scores. *J Pediatr Gastroenterol Nutr*. 2011;52(6):708-13.