

Estimating Confidence Intervals Around Ranks: An Example From the Wisconsin County Health Rankings



Daniel Zank, BS, Peter Vila, BS, Paul Peppard, PhD, Patrick Remington, MD, MPH
University of Wisconsin Population Health Institute

Introduction

- The Wisconsin County Health Rankings compiles publicly available data for all Wisconsin counties and weights these data to create summary rankings for health determinants and health outcomes
- Rankings appeal to our competitive nature and encourage direct comparisons, however these comparisons are sometimes problematic since the certainty of the rank is not generally known
- The “Health Behaviors” measure is an attempt to capture risk factors due to preventable behaviors such as cigarette smoking and physical inactivity.

Objective

Several of the Wisconsin County Health Rankings’ underlying measures are prevalence estimates obtained by telephone surveys.

These estimates introduce uncertainty, and although the Rankings are not presented with measures of sampling variability, it is important to have an appreciation of the degree of precision with which the Rankings are estimated.

This study estimates the precision of the 2005 Health Behaviors rank through a simulation study.

Methods

Wisconsin County Health Rankings:

•Health data from a number of sources, including the CDC and the Wisconsin Dept. of Health and Family Services, are compiled and calculated for each of Wisconsin’s 72 counties.

•The “Health Behaviors” component of the Rankings includes the items indicated in Figure 1.

•These measures are weighted and combined to create an overall “Health Behaviors” rank for each county.

Simulation Study:

•The large-sample estimated sampling distributions of each county-specific health behavior prevalence (p) measure was estimated as normally-distributed with mean p and standard deviation $\sqrt{p(1-p)/n}$.

•For each county and health measure, a random draw was obtained--using SAS software--from the corresponding estimated sampling distribution.

•These simulated rankings were used to create a new health behaviors ranking for each county.

•This process was repeated 1000 times.

•The county-specific 2.5th and 97.5th percentiles of the 1000 random draws estimated the 95% “confidence interval” of the individual county rankings.

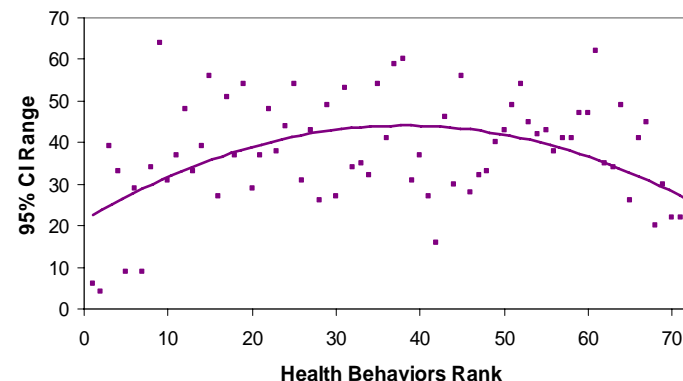
Figure 1. Wisconsin County Health Rankings – Health Behaviors measures



Figure 2. County Health Behavior Rank and 95% CIs

County	Health Behaviors Rank	95% Confidence Interval
Ozaukee	1	(1, 7)
Waukesha	2	(1, 5)
Sawyer	3	(1, 40)
Iron	4	(1, 34)
Washington	5	(2, 11)
Iowa	6	(1, 30)
Dane	7	(4, 13)
Richland	8	(1, 35)
Florence	9	(1, 65)
Pierce	10	(3, 34)
Vernon	11	(4, 41)
Bayfield	12	(4, 52)
Poik	13	(6, 39)
Green	14	(6, 45)
Buffalo	15	(3, 59)
Walworth	16	(8, 35)
Price	17	(4, 55)
Calumet	18	(6, 43)
Rusk	19	(4, 58)
Eau Claire	20	(10, 39)
Columbia	21	(8, 45)
Door	22	(6, 54)
Chippewa	23	(10, 48)
Clark	24	(8, 52)
Washburn	25	(6, 60)
Wood	26	(13, 44)
Sauk	27	(20, 63)
Marathon	28	(14, 40)
Oneida	29	(10, 59)
Sheboygan	30	(12, 39)
Vilas	31	(10, 63)
La Crosse	32	(18, 52)
Fond du Lac	33	(17, 52)
Outagamie	34	(19, 51)
Kewaunee	35	(9, 63)
Portage	36	(16, 57)
Jackson	37	(8, 67)
Lafayette	38	(7, 67)
Rock	39	(24, 55)
Dodge	40	(20, 57)
Brown	41	(27, 54)
Milwaukee	42	(39, 55)
Barron	43	(17, 63)
Winnebago	44	(27, 57)
Langlade	45	(12, 68)
Racine	46	(31, 59)
Manitowoc	47	(30, 62)
Kenosha	48	(29, 62)
Waupaca	49	(26, 66)
St. Croix	50	(17, 60)
Juneau	51	(20, 69)
Burnett	52	(16, 70)
Lincoln	53	(24, 69)
Waushara	54	(27, 69)
Trempealeau	55	(25, 68)
Marquette	56	(30, 68)
Dunn	57	(28, 69)
Grant	58	(27, 68)
Ashland	59	(23, 70)
Shawano	60	(18, 65)
Pepin	61	(9, 71)
Douglas	62	(35, 70)
Monroe	63	(36, 70)
Forest	64	(22, 71)
Jefferson	65	(43, 69)
Green Lake	66	(30, 71)
Crawford	67	(26, 71)
Oconto	68	(51, 71)
Taylor	69	(41, 71)
Adams	70	(49, 71)
Marquette	71	(49, 71)
Menominee	72	(72, 72)

Figure 3. Relationship between health behaviors rank and the range between lower and upper 95% confidence limits (R = 0.45)



Results

- Larger counties have narrower confidence intervals and thus less uncertainty
- Confidence interval size varies widely across Wisconsin counties, ranging from 1 (72,72) to 63 (9,64)
- Counties in the middle of the of the rankings have more uncertainty associated with rank due to more frequent change in rank of other counties

Conclusions

This method depends upon the assumption that the prevalence estimates are normally distributed, and ignores any uncertainty related to appropriate responses to survey questions.

The size of the confidence interval is affected by both sample size and the number of counties that change rank around the county in the ranking simulation.

As demonstrated by Figure 3, high and low ranks tend to be more robustly estimated than the intermediate ranks, an effect of the shifting of other counties’ ranks on the size of confidence intervals.

The Wisconsin County Health Rankings are intended to draw attention to and encourage discussion of population health issues in Wisconsin. However, over interpretation of the Rankings as a precise comparison of counties is not encouraged, especially in light of the inability to confidently discern between counties near the median rank.

References

Zank DC, Kaufman SK, Peppard PE, Remington PL, Kindig DA. Wisconsin County Health Rankings, 2005. University of Wisconsin Population Health Institute, 2005.