

## Do Indoor Toilets Cause Cancer?

A cohort of 100,000 persons aged 50 to 60 years of age was sampled in 1947 and followed for ten years. One of the parameters measured was whether or not the individual had an indoor toilet during at least half of those ten years. Another was whether or not the individual died from cancer within those ten years. **Among those who died, 8,460 of 9,360 = over 90% had had indoor toilets.** Wow, that means that having an indoor toilet causes cancer, right?

Of course not, it is just that most people had indoor toilets, possibly whether or not they died during that period. Here are the counts (contrived):

### Indoor\_Toilet \* Died Crosstabulation

Count

		Died		Total
		No	Yes	
Indoor_Toilet	No	900	100	1000
	Yes	8460	540	9000
Total		9360	640	10000

Holy moly, **among those who died, 540 had had indoor toilets and only 100 had not.** Best get rid of those indoor toilets to prevent death, eh? Of course not, the base rate of having an indoor toilet was very high. To make a claim about the association between plumbing and cancer you need to compute odds ratios or conditional probabilities. Of the 1,000 persons without indoor toilets,  $100/1,000 = 10\%$  died from cancer. Of the 9,000 who did have indoor toilets  $540/9,000 = 6\%$  had cancer. The cancer death rate was higher among those without indoor toilets than those with indoor toilets!

### Indoor\_Toilet \* Died Crosstabulation

			Died		Total
			No	Yes	
Indoor_Toilet	No	Count	900	100	1000
		% within Indoor_Toilet	90.0%	10.0%	100.0%
	Yes	Count	8460	540	9000
		% within Indoor_Toilet	94.0%	6.0%	100.0%
Total	Count		9360	640	10000
	% within Indoor_Toilet		93.6%	6.4%	100.0%

The odds of cancer death among those without indoor toilets was  $100/900$ . Among those with indoor toilets the odds was  $540/8,460$ . The odds ratio is  $(100/900)/(540/8460) = 1.74$ . The odds of death from cancer were 1.74 times higher for those without indoor toilets than for those with indoor toilets.

### Chi-Square Tests

	Value	df	Asymptotic Significance (2- sided)	Exact Sig. (2- sided)	Exact Sig. (1- sided)
Pearson Chi-Square	24.038 <sup>a</sup>	1	.000		

### Symmetric Measures

		Value	Approximate Significance
Nominal by Nominal	Phi	-.049	.000
	Cramer's V	.049	.000
N of Valid Cases		10000	

### Risk Estimate

	Value	95% Confidence Interval	
		Lower	Upper
Odds Ratio for Indoor_Toilet (No / Yes)	.574	.459	.719

SPSS put the smaller odds in the denominator. Odds ratios less than 1 are difficult for many people to report, so I usually put the larger odds in the numerator. Inverting the SPSS odds ratio,  $1/.574$ , will give you the same odds ratio I got, 1.74. Doing the same with the confidence interval, 95% CI [1.39, 2.18].

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