Statistical properties of sensitivity and specificity of diagnostic tests

ICID 2024

P-198

Soichi Takeishi MD, Tatsuo Inoue MD, Koichi Miyamura MD, PhD

Infection Control Committee, Inuyama Chuo General Hospital

Background

- There are various studies to evaluate the sensitivity and specificity of diagnostic tests with respect to the detection of infections.
- In these studies, the proportion of patients with positive diagnostic tests varies.
- Theoretically, when the positive and negative predictive values are fixed, an increased proportion of patients with positive diagnostic tests leads to higher sensitivity and lower specificity.

	True	False			
Positive	40	10	50	Positive predictive values	80
Negative	10	40	50	Negative predictive values	80
	50	50	100		
	Sensitivity	Specificity			
	80	80			

→

	True	False			
Positive	72	18	90	Positive predictive values	80
Negative	2	8	10	Negative predictive values	80
	74	26	100		
	Sensitivity	Specificity			
	97.3	30.8			

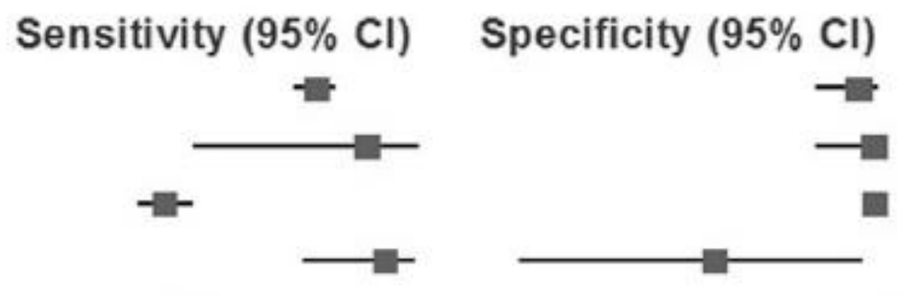
- For example, if the true positive is 40, false positive is 10, false negative is 10, and true negative is 40, the positive and negative predictive values are both 80%, the proportion of patients with positive diagnostic tests (all patients with positive diagnostic tests ÷ all patients × 100 [%]) is 50%, and sensitivity and specificity are both 80%.
- Compared to the left, if the true positive is 72, false positive is 18, false negative is 2, and true negative is 8, the positive and negative predictive values both remain 80%, the proportion of patients with positive diagnostic tests increases to 90%, the sensitivity increases to 97.3%, and the specificity decreases to 30.8%.

- We examined whether these statistical properties had appeared in actual studies, using the data in the meta-analysis.

Research design & Methods

- We conducted a meta-analysis using data from a previous meta-analysis, including 67 studies providing the number of true positive, false positive, false negative, and true negative, sensitivity and specificity of the cytomegalovirus (CMV) antigenemia assay using PCR as the reference standard.

Study	TP	FP	FN	TN	Sensitivity (95% CI)	Specificity (95% CI)
Allice 2006	239	4	77	55	0.76 [0.71, 0.80]	0.93 [0.84, 0.98]
Ashokkumar 2015	7	1	1	30	0.88 [0.47, 1.00]	0.97 [0.83, 1.00]
Beckmann 2011	99	14	145	462	0.41 [0.34, 0.47]	0.97 [0.95, 0.98]
Bergallo 2008	22	2	2	3	0.92 [0.73, 0.99]	0.60 [0.15, 0.95]



.
.
.

67 studies

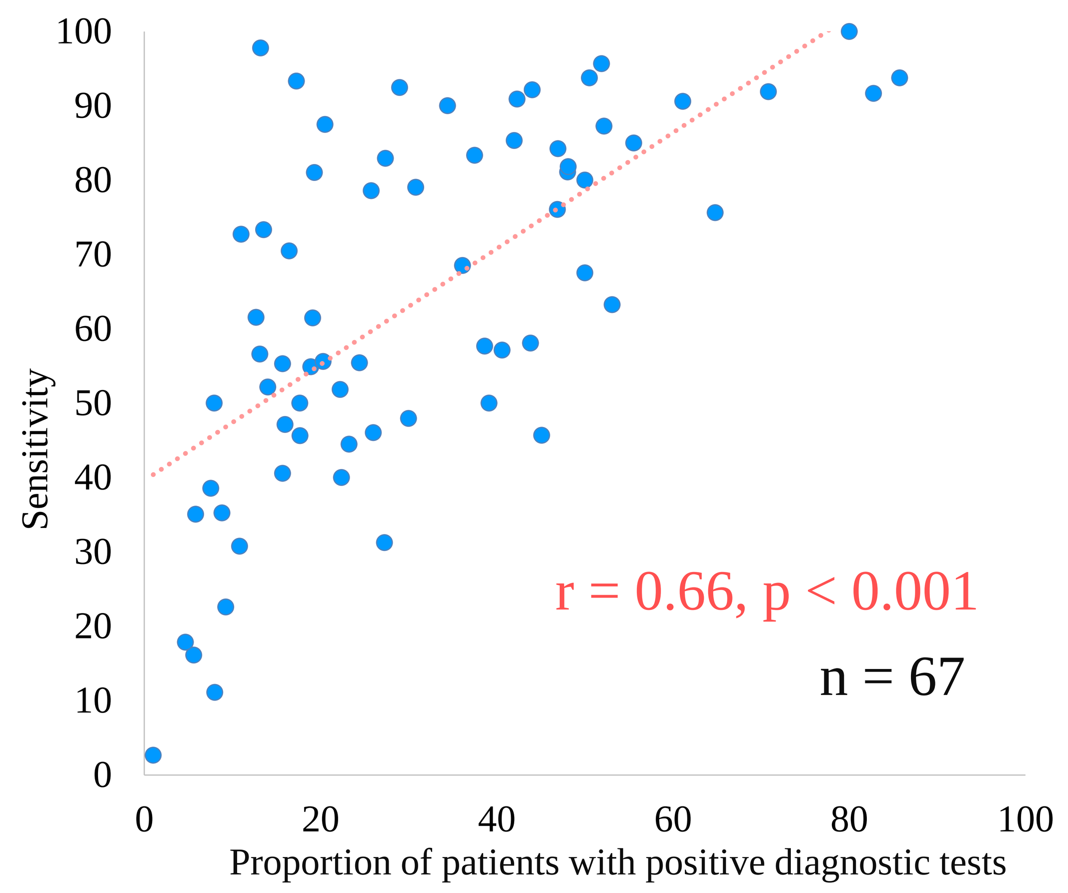
Eguchi H, et al. Clin Microbiol Infect. 2017;23:907-915.

- We defined "proportion of patients with positive diagnostic tests" as "all patients with positive diagnostic tests ÷ all patients × 100 (%)."
- We evaluated a correlation between the sensitivity or specificity and proportion of patients with positive diagnostic tests in the 67 studies using the Pearson product-moment correlation coefficient.

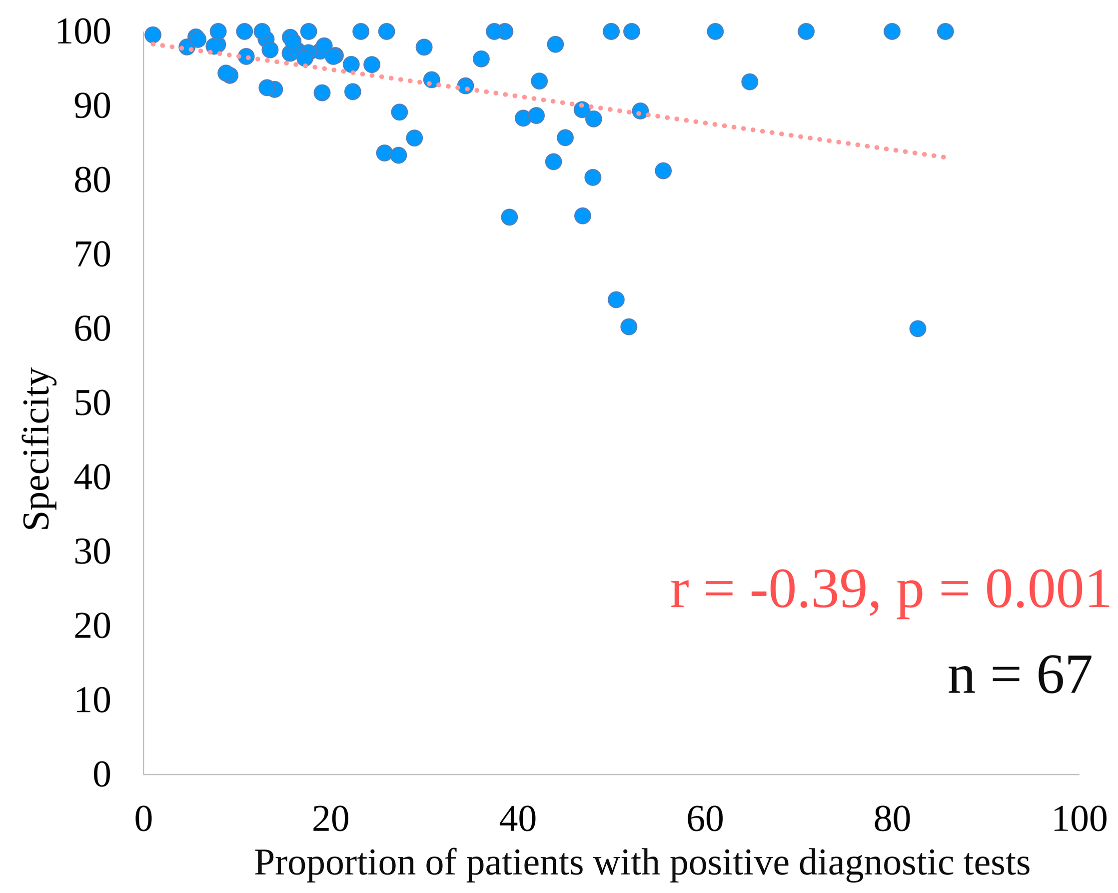
Results

Sample characteristics

n = 67	Mean ± standard deviation
Proportion of patients with positive diagnostic tests, %	31.2 ± 20.3
Sensitivity, %	64.0 ± 24.0
Specificity, %	92.9 ± 9.3



The sensitivity was significantly positively correlated with the proportion of patients with positive diagnostic tests.



The specificity was significantly negatively correlated with the proportion of patients with positive diagnostic tests.

Discussion

- The present study results suggest that an increased proportion of patients with positive diagnostic tests leads to higher sensitivity and lower specificity.
- Unifying the proportion of patients with positive diagnostic tests is realistically impossible; therefore, an evaluation by meta-analysis is desirable.

Contact information

Soichi Takeishi, MD

Department of Internal medicine, Inuyama Chuo General Hospital

6, Futagozuka, Goromaru, Inuyama-city, Aichi, 484-8511, Japan.

Phone: +81-568-62-8111

E-mail:souichi19811225@yahoo.co.jp

Conclusion

An increased proportion of patients with positive diagnostic tests leads to higher sensitivity and lower specificity.