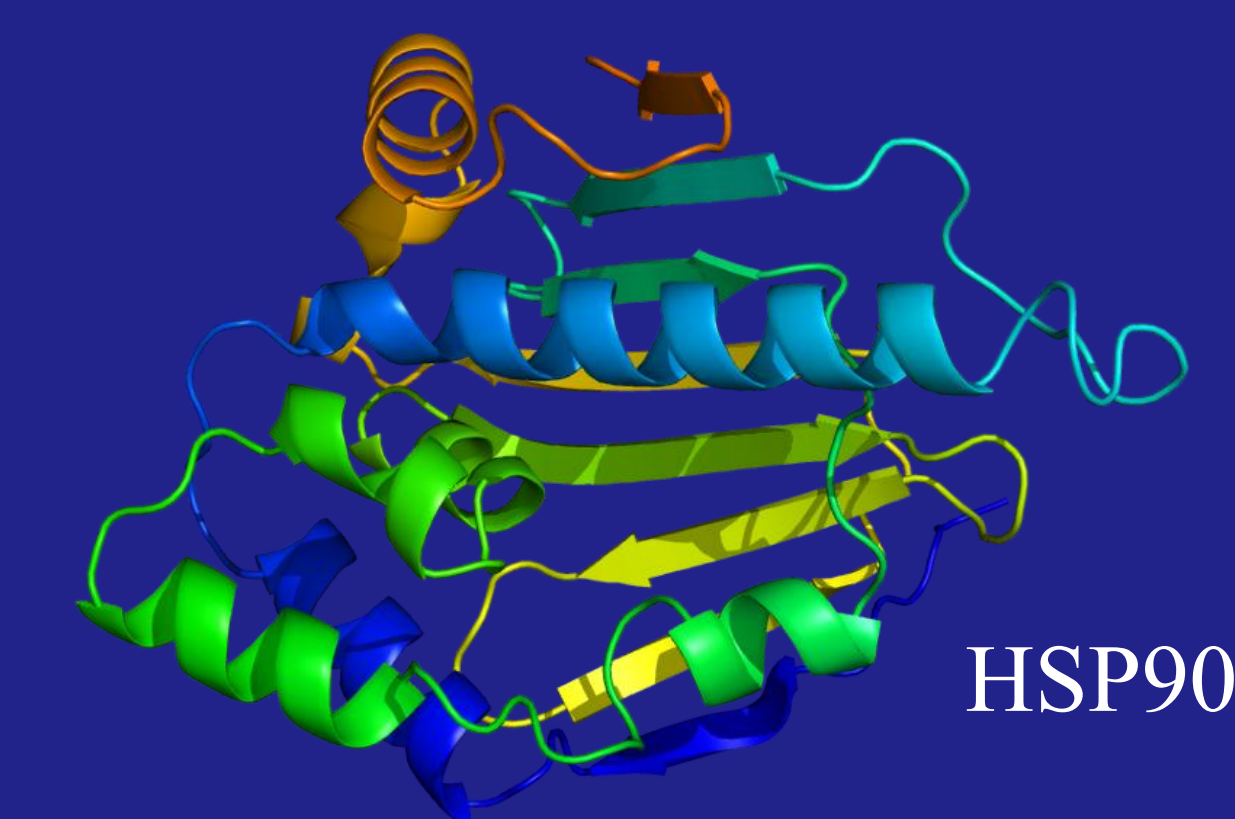


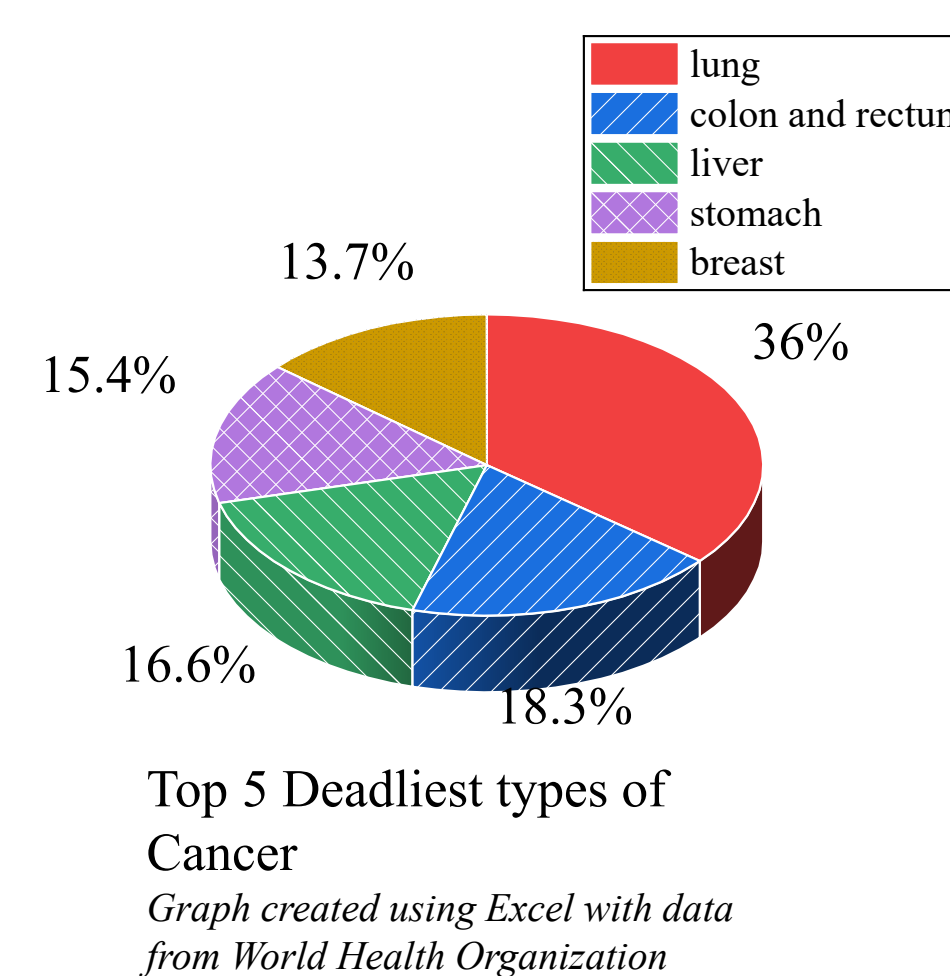
# Systematic Validation of Using HSP90 $\alpha$ as a Lung Cancer Diagnostic Biomarker for Enhanced Clinical Screening



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## Background

Lung cancer is responsible for over 2 million deaths every year, largely because 84% of patients receive medical treatment late. Current methods of diagnosis such as



biopsies are inaccurate and very costly. Biomarkers offer a more cost-efficient and accurate solution. Heat Shock Proteins (HSPs) are chaperones that ensure correct folding. HSPs are frequently overexpressed in tumor cells to help them survive environmental stress. Because HSPs correlate with drug resistance, metastasis, and poor patient survival, they can serve as valuable biomarkers for diagnosis. However, limited studies have been done to synthesize its accuracy in lung cancer diagnosis.

## Objective

The goal of this study was to perform a systematic analysis to evaluate the diagnostic performance and clinical utility of HSP90 $\alpha$  as a biomarker for detecting lung cancer.

## Materials and Methods

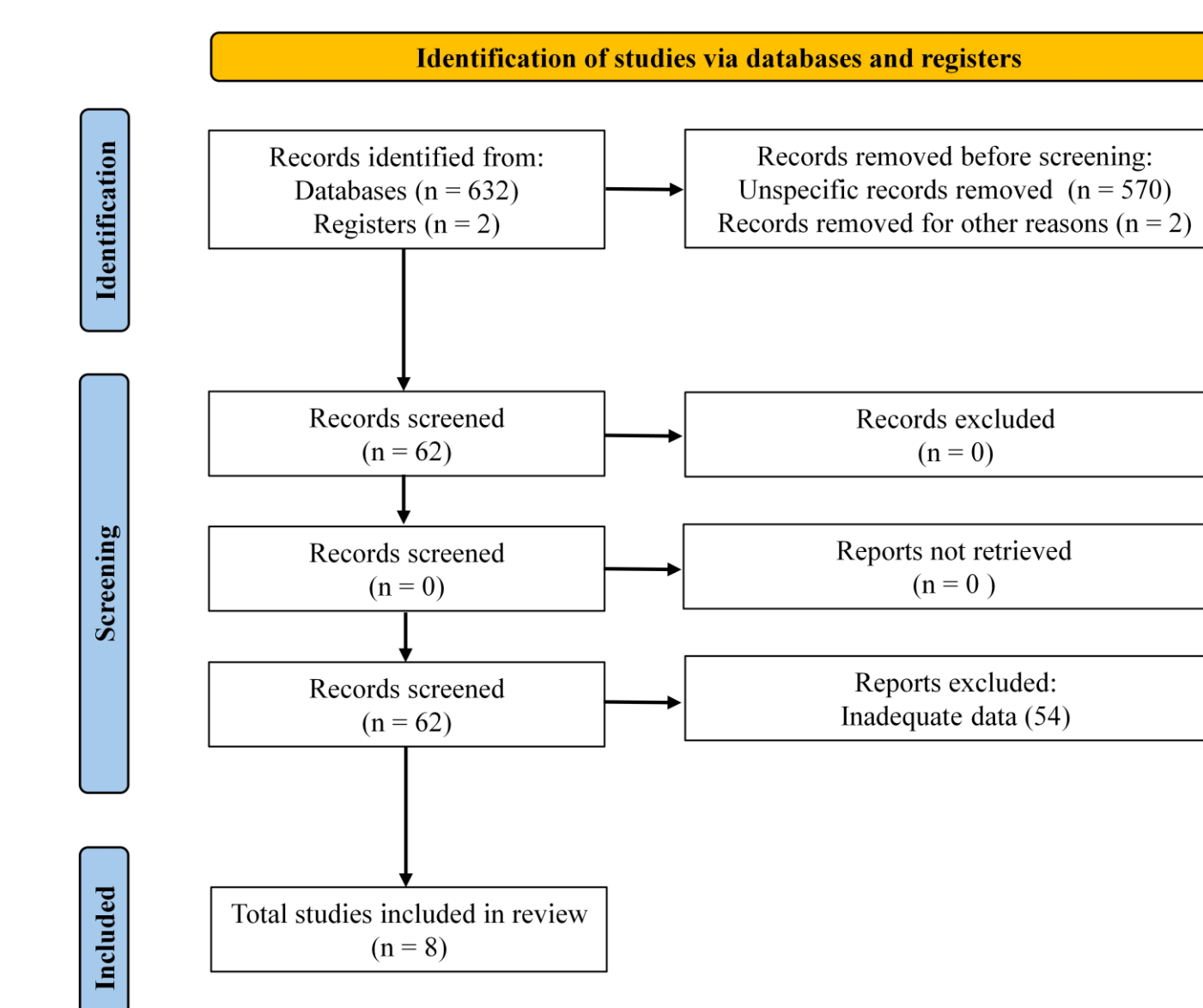
Literature on HSP90 $\alpha$  and lung cancer was found using PubMed and PROSPERO, and 8 studies out of 632 papers and 2 registers were selected for this study. Information on 3,624 patients (2,080 lung cancer patients and 1,544 healthy controls) was analyzed.

	Healthy control	Cancer patient
High HSP90 $\alpha$	False Positive (FP)	True Positive (TP)
Low HSP90 $\alpha$	True Negative (TN)	False Negative (FN)

Specificity =  $\frac{TN}{FP+TN}$       Sensitivity =  $\frac{TP}{TP+FN}$

## Results

### Flow chart of included and excluded studies



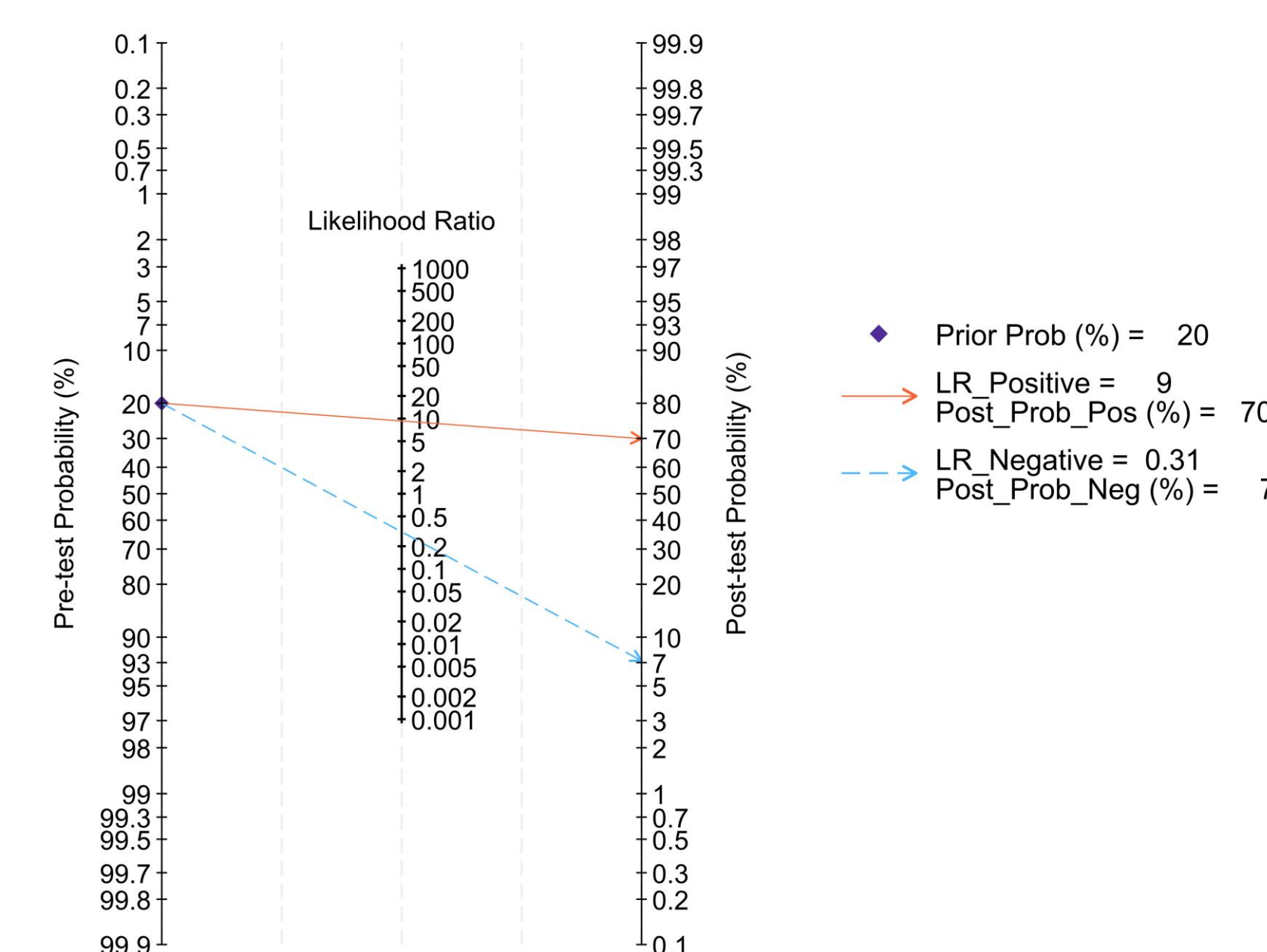
### Information on Patients in Included Studies

HSP90 $\alpha$ Cut-off value (ng/mL)	Number of cancer patients	Number of Healthy Controls	Total number of patients	Sensitivity	Specificity	Reference
49.8	45	45	90	82.2%	100.0%	(Jain et al., 2025)
101.8	76	69	145	55.3%	95.2%	(Wang et al., 2022)
114.8	92	83	175	68.5%	97.3%	(Wang et al., 2022)
103.0	37	34	71	70.3%	96.0%	(Wang et al., 2022)
50.0	175	160	335	88.1%	69.7%	(Yuan et al., 2022)
71.5	312	160	472	66.3%	95.0%	(Wang et al., 2021)
56.3	1,294	953	2,247	72.2%	78.7%	(Shi et al., 2014)
NA	49	40	89	59.0%	58.0%	(Zhong et al., 2003)

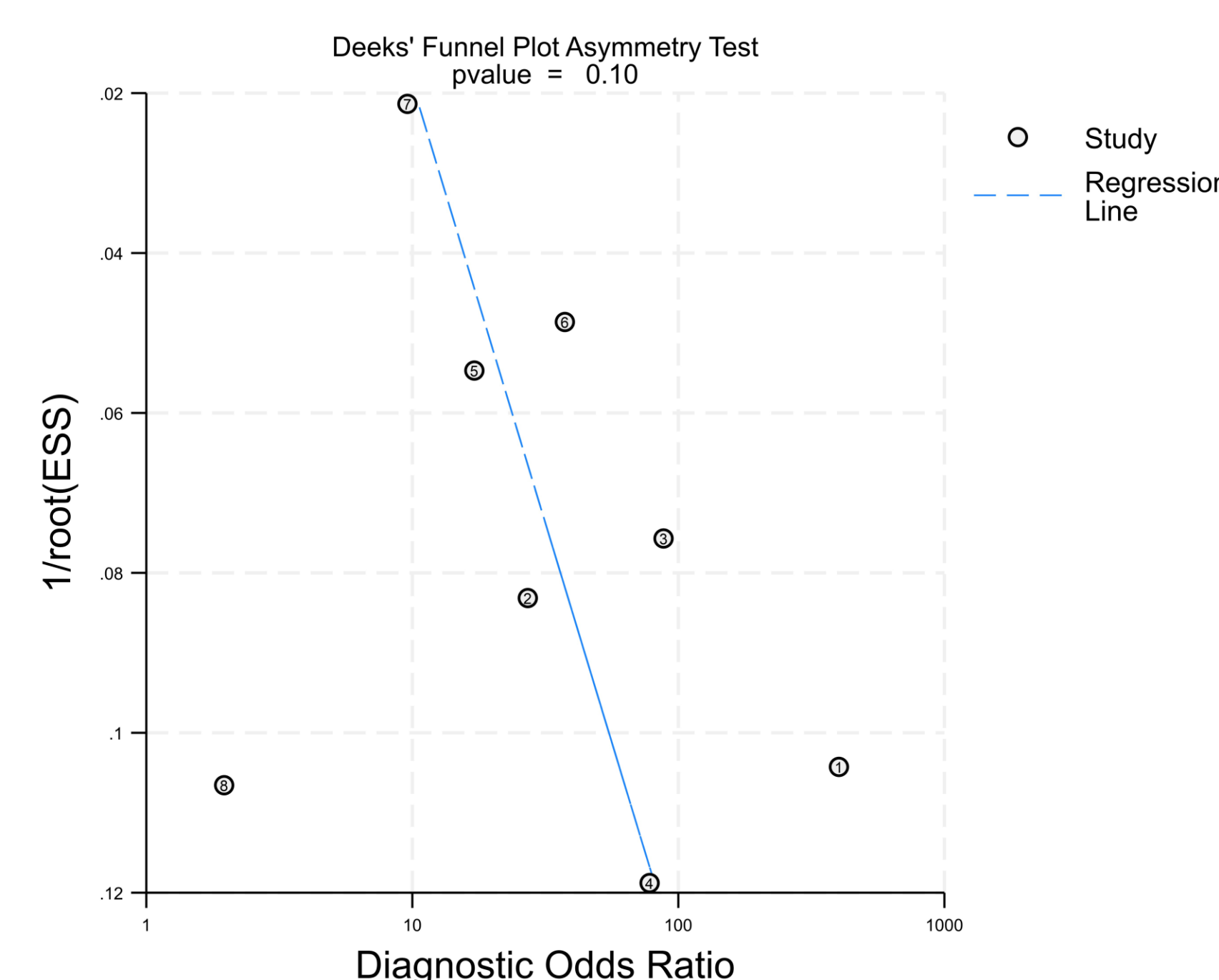
### Summary data and performance estimates

- Number of studies = 8
- ROC Area, AUROC = 0.84 [0.80 - 0.87]
- Heterogeneity (Chi-square): LRT\_Q = 97.894, df = 2.00, LRT\_p = 0.000
- Inconsistency (I-square): LRT\_I2 = 98, 95% CI = [ 97 - 99]
- Parameter                      Estimate                      95% CI
- Sensitivity                      0.71                      [0.63, 0.78]
- Specificity                      0.92                      [0.80, 0.97]
- Positive Likelihood Ratio      9.3                      [3.4, 25.3]
- Negative Likelihood Ratio    0.31                      [0.24, 0.41]
- Diagnostic Odds Ratio        30                      [10, 91]

### Fagan's Nomogram



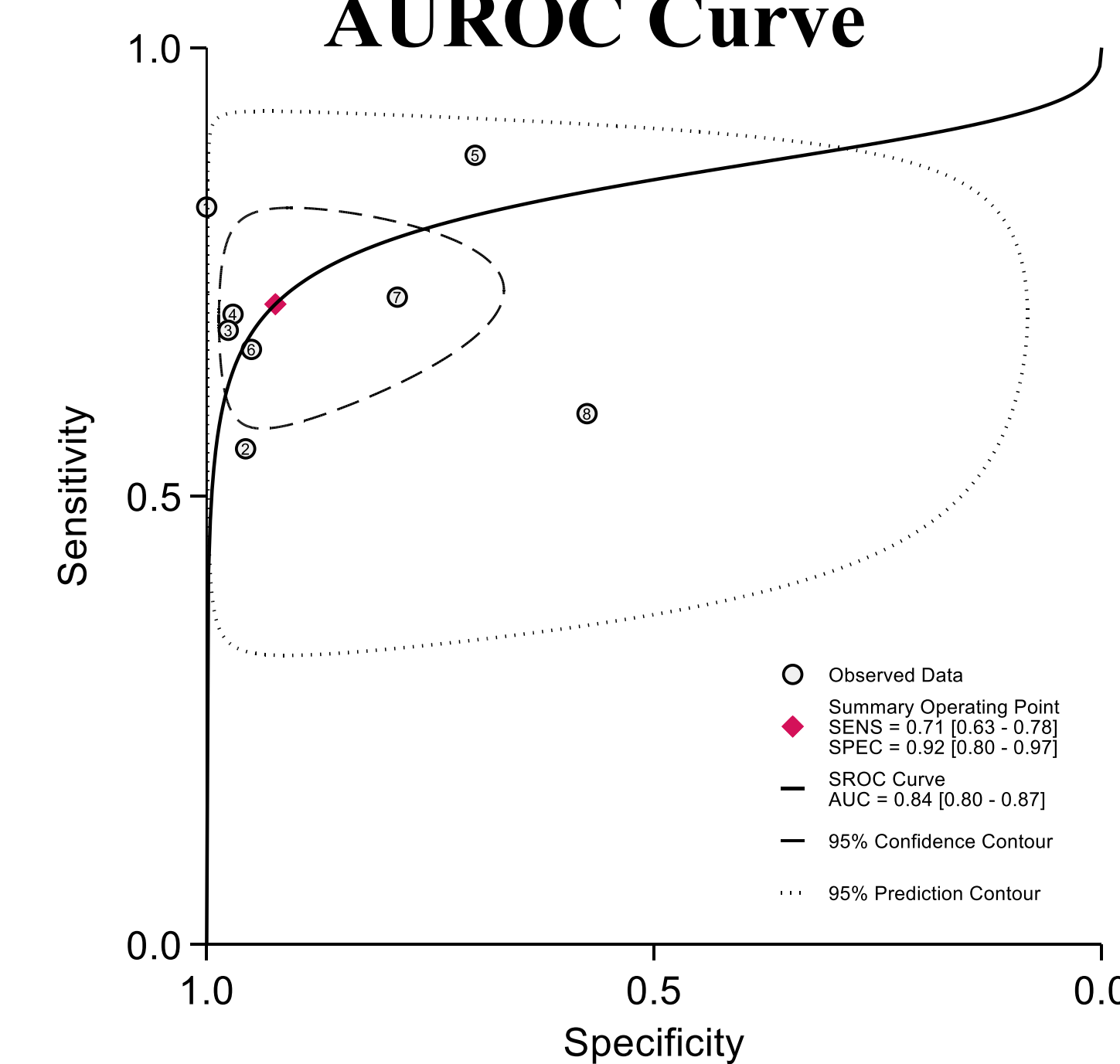
### Deeks' Funnel Plot



The diagnostic accuracy of HSP90 $\alpha$  is consistent across studies of varying power.

Graph created by finalist using STATA software

### AUROC Curve



Negative correlation between sensitivity and specificity of using HSP90 $\alpha$  as an effective biomarker for lung cancer diagnosis; AUROC curve = 0.84

Graph created by finalist using STATA software

## Conclusions

- Analysis of 3,624 patients with high accuracy establish HSP90 $\alpha$  as a robust, scalable biomarker for cancer screening and clinical monitoring.
- Despite varying clinical cut-off values (49.8 to 114.8 ng/mL), diagnostic performance remained statistically stable ( $p > 0.05$ ), showing HSP90 $\alpha$  is a widely applicable biomarker.
- Fagan's Nomogram reveals that a positive test result dramatically increases the probability of disease by 50%, and can be used to strengthen clinical decision-making.
- Extremely efficient AUROC Curve of 0.84, showing HSP90 $\alpha$  can properly distinguish between cancerous and non-cancerous patients 84% of the time.
- Substantially more cost-efficient and non-invasive diagnostic tool compared to current treatment options such as biopsies.

## References

Ahn et al. (2025) *Front Pharmacol* 16: 1522285; Board of Governors of the Federal Reserve System (2025); Capan et al. (2025) *Drug Dev Res* 86(3): e70092; Chiu et al. (2021) *Clinicoecon Outcomes Res* 13: 191-200; Ciocca et al. (2005) *Cell Stress Chaperones* 10(2): 86-103; Cyran et al. (2022) *Front Oncol* 12: 860320; Dwamena, B. (2007) *Statistical Software Components*; Guo et al. (2021) *Oncol Lett* 22(2): 630; Hu et al. (2022) *MedComm* 3(3): e161; Jain et al. (2025) *Asian Pac J Cancer Prev* 26(10): 3797-3803; Kabut et al. (2025). *Cells* 14(20); Liu et al. (2024). *Discov Oncol* 15(1): 151; Mazurakova et al. (2023). *Adv Med Sci* 68(2): 464-473; Nakamura et al. (2024). *World J Gastrointest Oncol* 16(4): 1578-1595; Page et al. (2021) *BMJ* 372: n71; Pockley (2003) *The Lancet* 362(9382): 469-476; Shi et al. (2014) *Clin Cancer Res* 20(23): 6016-6022; Tustumi et al. (2022) *Cells* 11(17); Wang et al. (2022). *Turk J Med Sci* 52(3): 747-753; Wang et al. (2021) *Oncol Res Treat* 44(11): 583-589; World Health Organization (2025); Yuan et al. (2022) *J Clin Lab Anal* 36(6): e24462; Zhang et al. (2020) *Lung Cancer Manag* 9(4): Lmt40; Zhong et al. (2003) *Cancer Detect Prev* 27(4): 285-290; Zuo et al. (2024). *J Hematol Oncol* 17(1): 81.