Dimensionless Index as a Prognostic Marker of Mortality in Aortic Stenosis with Preserved Ejection Fraction

A Meta-analysis and Systematic Review

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Disclosure

- I, Hriday Shah, DO NOT have any financial relationships to disclose.

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Co-Investigators

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Background

- Aortic stenosis (AS) is a common valvular heart disease in aging populations.
- Causes: degenerative calcification or congenital bicuspid valve.
- Severity assessment: Aortic Valve Area (AVA), jet velocity, gradient—limited in preserved Ejection Fraction (EF).

Pathophysiology:

- Increased LV afterload → hypertrophy, fibrosis, decreased compliance.
- Traditional parameters are flow-dependent and may misclassify severity.

Limitations of Current Assessment

- AVA estimation depends on Left ventricular outflow tract (LVOT) geometry and flow.
- Echocardiography can underestimate AVA due to turbulence or shape distortion.

Understanding the Dimensionless Index (DI)

The Dimensionless Index (DI) is a ratio used in echocardiography to assess Aortic Stenosis (AS) severity.

Formula: DI = LVOT Velocity Time Integral ÷ Aortic Jet Velocity Time Integral.

- **LVOT VTI (Left Ventricular Outflow Tract Velocity Time Integral)**
- Measures blood flow speed and distance in the LVOT during systole.
- Reflects how far blood moves out of the left ventricle with each beat (“stroke distance”).
- Used to estimate stroke volume and cardiac output.

- **Aortic VTI (Aortic Jet Velocity Time Integral)**
- Measures velocity and distance of blood flow through the aortic valve.
- Reflects how fast blood passes the aortic valve — higher in stenosis.
- Used with LVOT VTI to calculate the Dimensionless Index (DI) for aortic stenosis severity.

Objective

- To assess mortality in AS patients with DI ≤ 0.25 vs ≥ 0.25 and preserved EF.
- Primary endpoint: Overall mortality.

Methods

- Systematic review & meta-analysis per PRISMA guidelines.
- Databases: PubMed, Cochrane, EMBASE, Scopus, Google Scholar (till July 2025).
- Random-effects model using RevMan 5.4.

Selection Criteria

- Inclusion: AS with preserved EF, clear DI values.
- Exclusion: Mitral disease, prosthetic valves, AVA > 2.0 cm^2, pediatrics, <10 patients.

Results Summary

- 5 studies (3 observational, 2 abstracts) included.
- DI ≤ 0.25 associated with higher mortality (HR 1.69 [95% CI 1.46–1.97], p<0.00001).
- Low heterogeneity (I^2=26%).

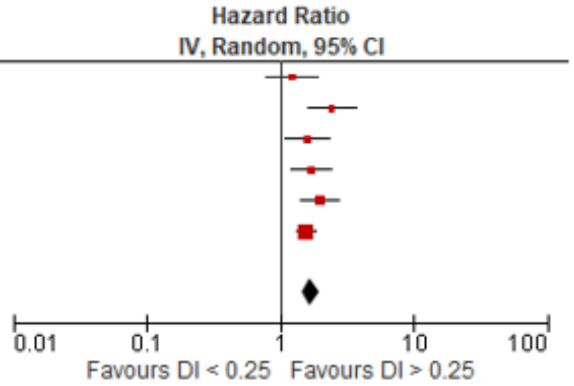
Forest Plot – Mortality

- Visual representation of pooled Hazard Ratios.
- HR consistently >1.5 for DI ≤ 0.25 group.
- Indicates strong association with mortality.

Fig 1: Forest plot for **overall mortality**

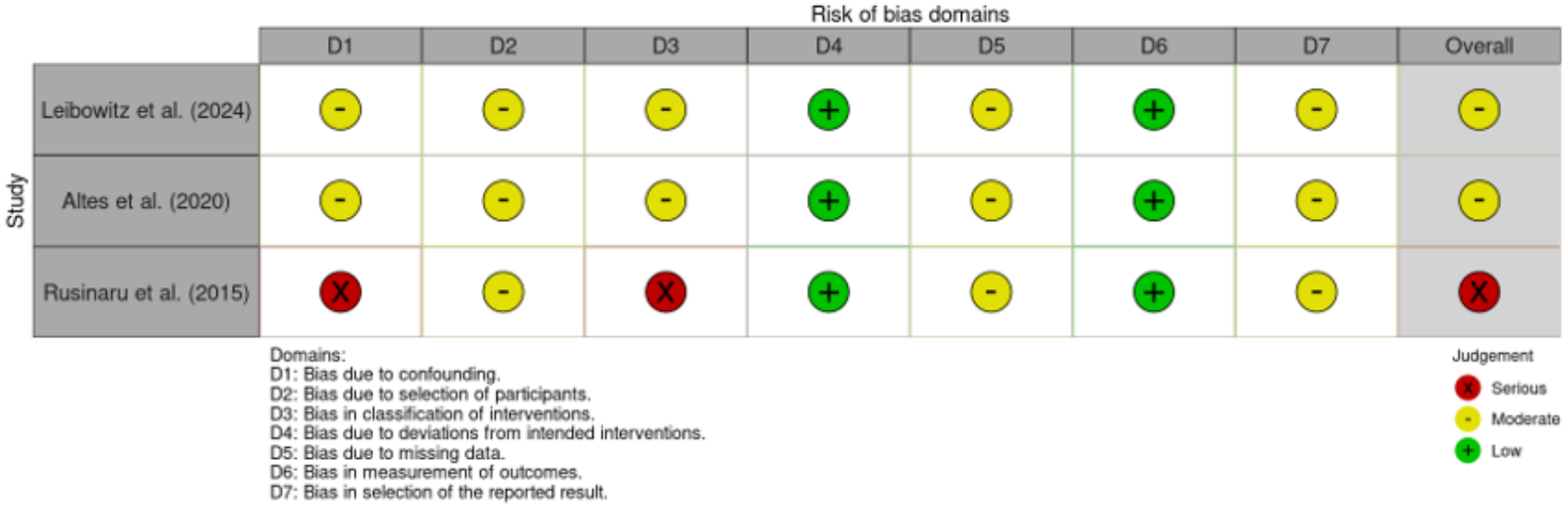
Study or Subgroup	log[Hazard Ratio]	SE	Weight	Hazard Ratio IV, Random, 95% CI
Rusinaru et al 2015	0.207	0.2324	9.3%	1.23 [0.78, 1.94]
Altes et al 2021	0.8879	0.2069	11.3%	2.43 [1.62, 3.65]
Namasivayam et al 2024 (1)	0.47	0.1912	12.8%	1.60 [1.10, 2.33]
Namasivayam et al 2024 (2)	0.5306	0.1777	14.4%	1.70 [1.20, 2.41]
Altes et al 2020	0.678	0.1635	16.3%	1.97 [1.43, 2.71]
Leibowitz et al 2024	0.4447	0.0852	35.9%	1.56 [1.32, 1.84]
Total (95% CI)			**100.0%**	**1.69 [1.46, 1.97]**

Heterogeneity: $Tau^2 = 0.01$; $Chi^2 = 6.74$, df = 5 (P = 0.24); $I^2 = 26\%$
Test for overall effect: Z = 6.89 (P < 0.00001)



Sensitivity & Bias Assessment

Figure 2: Quality Assessment using ROBINS-I V2 tool



Discussion

- DI < 0.25 is a strong predictor of mortality in AS with preserved EF.
- DI complements AVA and gradient in assessing severity.
- Independent of flow and geometry, improving accuracy.

Clinical Implications

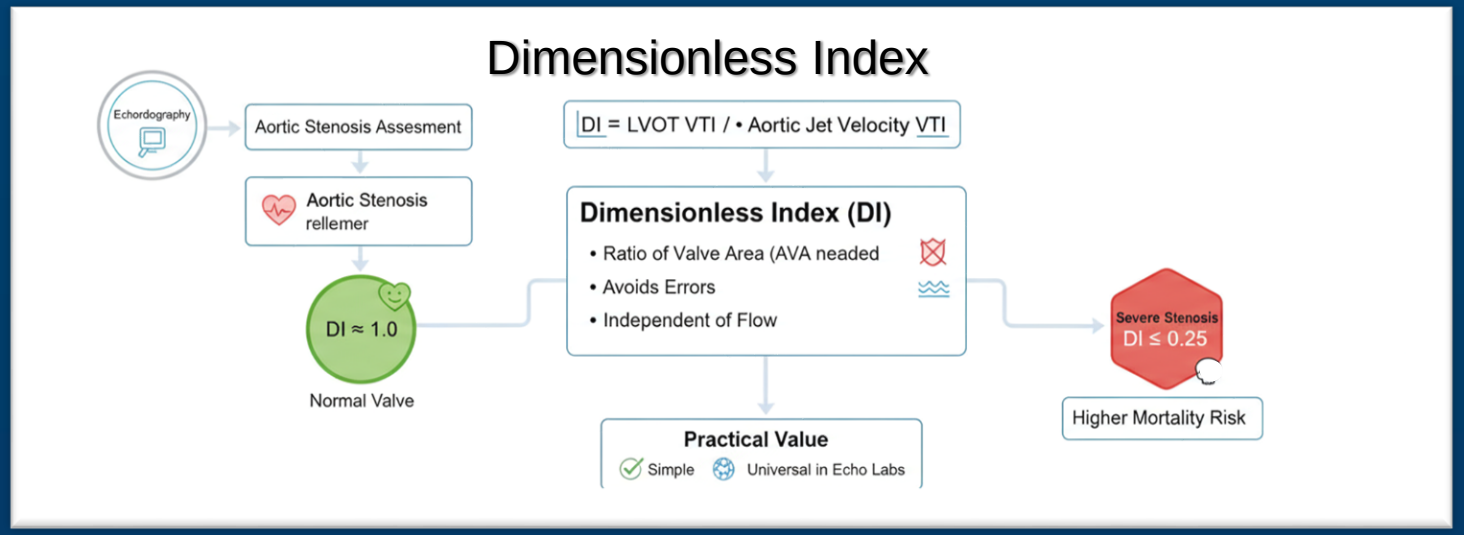
- Incorporate DI with standard Doppler parameters for SAS.
- Improves sensitivity and prognostic accuracy.
- May guide earlier valve replacement decisions.

Limitations

- Small number of included studies and limited demographics.
- Abstract-only data reduced robustness of quality assessment.

Conclusion

- DI ≤ 0.25 predicts higher mortality in AS with preserved EF.
- Useful for risk stratification and guiding valve intervention.
- Future research needed for DI in low- vs normal-flow AS.



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