Sex and Racial Differences in Aortic Dimensions: Implications for Treatment

Houston Aortic Symposium
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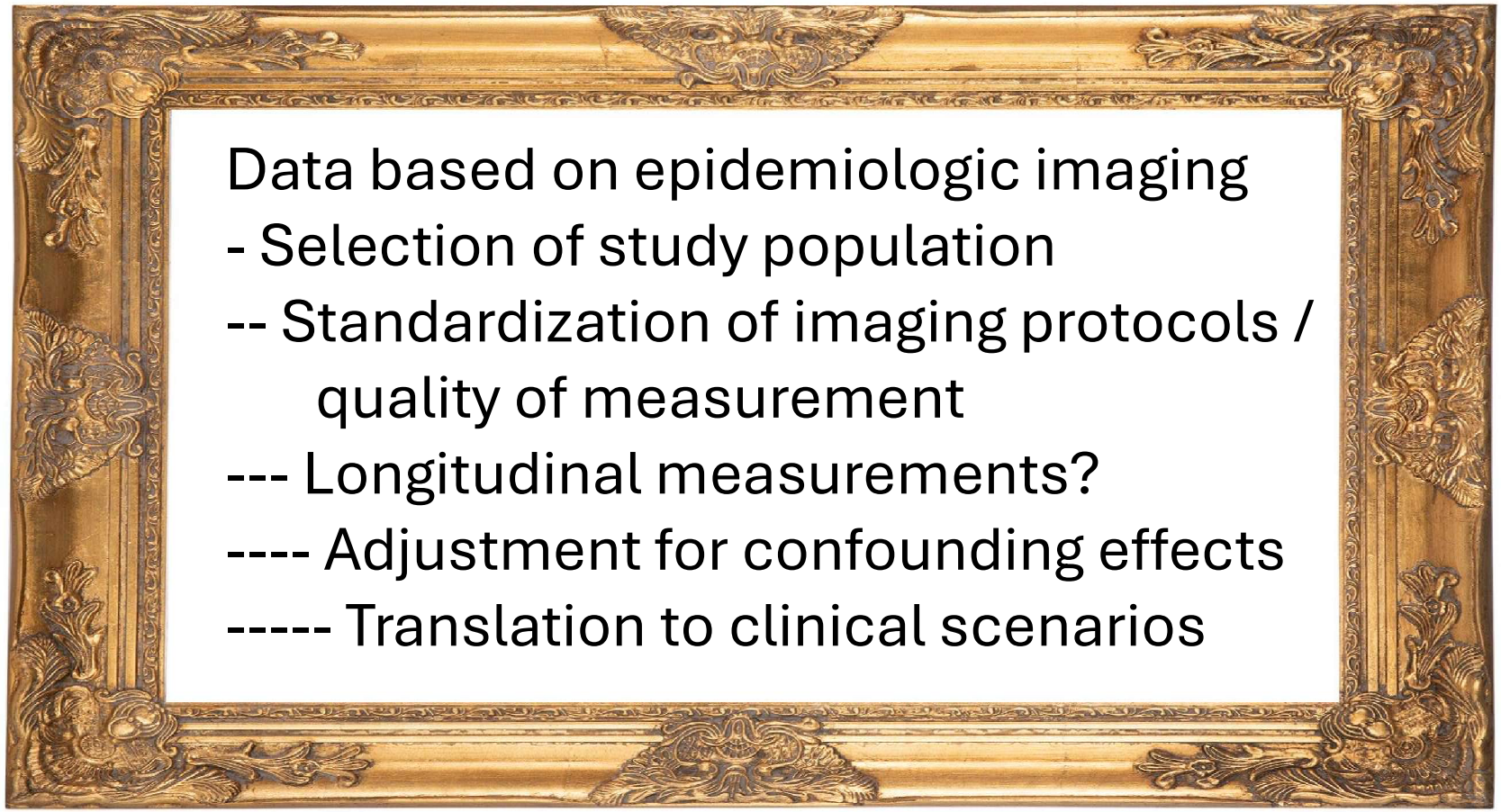
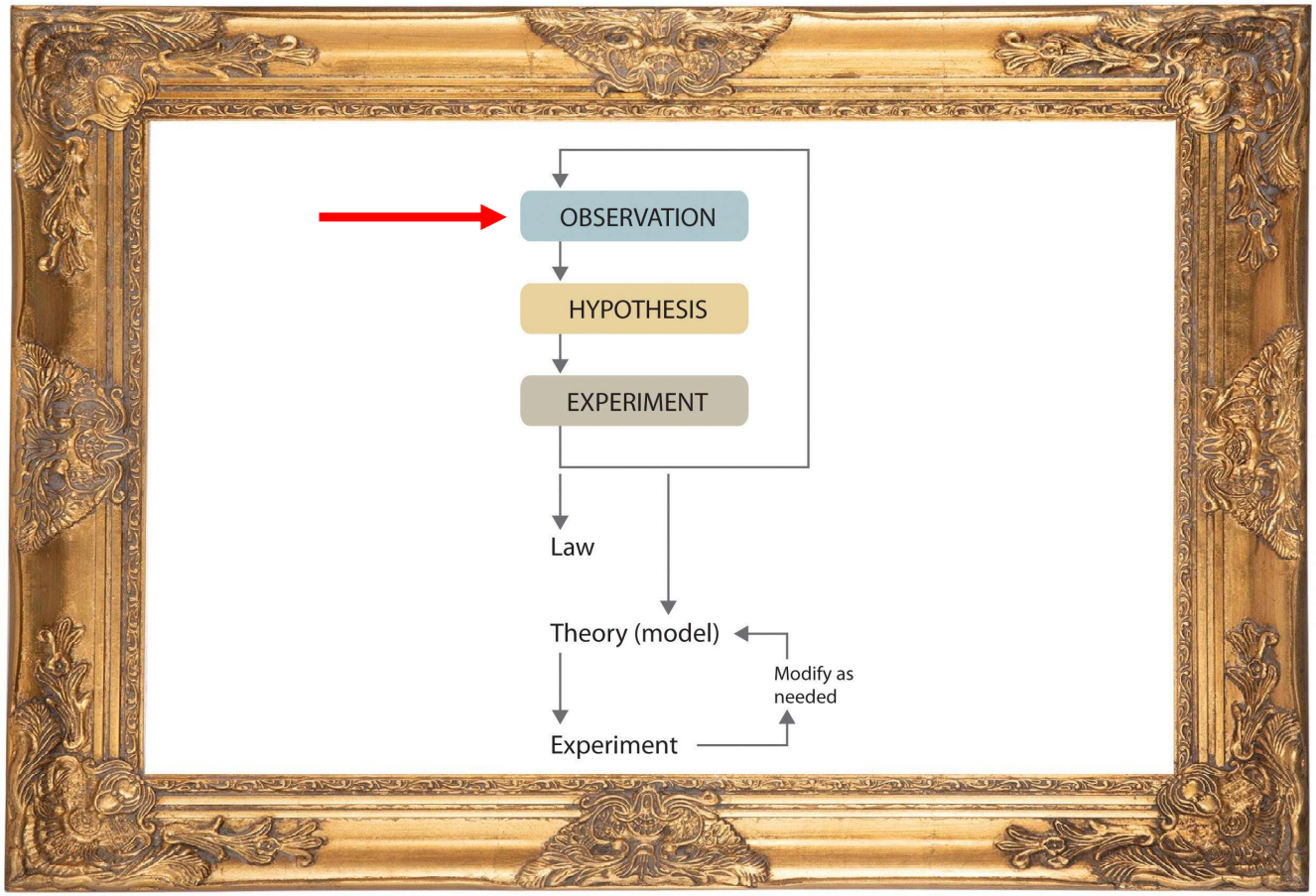
- Disclosures: None

Sex and Racial Differences in Aortic Dimensions



Sex and Racial Differences in Aortic Dimensions



Normal Values of Aortic Root Size According to Age, Sex, and Race: Results of the World Alliance of Societies of Echocardiography Study

Table 2 Aortic measures according to sex

	All subjects (n = 1,585)	Men (n = 799)	Women (n = 786)
Aortic annular diameter, mm	20.4 ± 2.3	21.2 ± 2.2	19.5 ± 2.1*
BSA-indexed annular diameter, mm/m^2	11.6 ± 1.4	11.3 ± 1.3	11.9 ± 1.4*
Height-indexed annular diameter, mm/m	12.2 ± 1.2	12.3 ± 1.2	12.2 ± 1.3
Height$^{2.13}$-indexed annular diameter, mm/m$^{2.13}$	6.9 ± 0.9	6.6 ± 0.8	7.2 ± 0.9
Aortic SoV diameter, mm	30.8 ± 3.9	32.2 ± 3.7	29.3 ± 3.6*
BSA-indexed aortic SoV diameter, mm/m^2	17.6 ± 2.6	17.2 ± 2.5	18.0 ± 2.6*
Height-indexed aortic SoV diameter, mm/m	18.5 ± 2.3	18.6 ± 2.3	18.4 ± 2.3*
Height$^{2.13}$-indexed aortic SoV diameter, mm/m$^{2.13}$	10.4 ± 1.6	10.1 ± 1.5	10.8 ± 1.6
Aortic STJ diameter, mm	26.6 ± 3.7	27.7 ± 3.7	25.5 ± 3.3*
BSA-indexed aortic STJ diameter, mm/m^2	15.2 ± 2.4	14.8 ± 2.3	15.6 ± 2.4*
Height-indexed aortic STJ diameter, mm/m	16.0 ± 2.2	16.0 ± 2.2	15.9 ± 2.2
Height$^{2.13}$-indexed aortic STJ diameter, mm/m$^{2.13}$	9.0 ± 1.5	8.7 ± 1.4	9.4 ± 1.5

Data are expressed as mean ± SD or as number (percentage).

*P < .05, men versus women

J Am Soc Echocardiogr . 2022 Mar;35(3):267-274.

Normal Values of Aortic Root Size According to Age, Sex, and Race: Results of the World Alliance of Societies of Echocardiography Study

Table 2 Aortic measures according to sex

	All subjects (*n* = 1,585)	BSA 1.77	Men (*n* = 799)	Women (*n* = 786)
Aortic annular diameter, mm	20.4 ± 2.3		21.2 ± 2.2	19.5 ± 2.1*
BSA-indexed annular diameter, mm/m^2	11.6 ± 1.4		11.3 ± 1.3	11.9 ± 1.4*
Height-indexed annular diameter, mm/m	12.2 ± 1.2		12.3 ± 1.2	12.2 ± 1.3
Height$^{2.13}$-indexed annular diameter, mm/m$^{2.13}$	6.9 ± 0.9		6.6 ± 0.8	7.2 ± 0.9
Aortic SoV diameter, mm	30.8 ± 3.9		32.2 ± 3.7	29.3 ± 3.6*
BSA-indexed aortic SoV diameter, mm/m^2	17.6 ± 2.6		17.2 ± 2.5	18.0 ± 2.6*
Height-indexed aortic SoV diameter, mm/m	18.5 ± 2.3		18.6 ± 2.3	18.4 ± 2.3*
Height$^{2.13}$-indexed aortic SoV diameter, mm/m$^{2.13}$	10.4 ± 1.6		10.1 ± 1.5	10.8 ± 1.6
Aortic STJ diameter, mm	26.6 ± 3.7		27.7 ± 3.7	25.5 ± 3.3*
BSA-indexed aortic STJ diameter, mm/m^2	15.2 ± 2.4		14.8 ± 2.3	15.6 ± 2.4*
Height-indexed aortic STJ diameter, mm/m	16.0 ± 2.2		16.0 ± 2.2	15.9 ± 2.2
Height$^{2.13}$-indexed aortic STJ diameter, mm/m$^{2.13}$	9.0 ± 1.5		8.7 ± 1.4	9.4 ± 1.5

Data are expressed as mean ± SD or as number (percentage).

*$P <$ .05, men versus women

J Am Soc Echocardiogr . 2022 Mar;35(3):267-274.

Normal Values of Aortic Root Size According to Age, Sex, and Race: Results of the World Alliance of Societies of Echocardiography Study

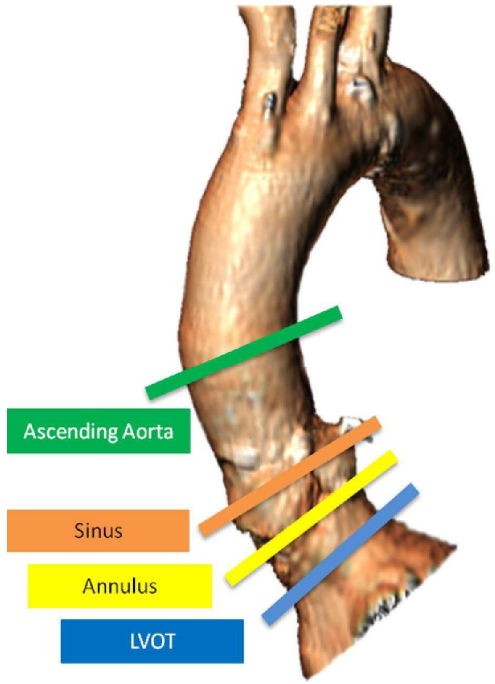
Table 4 Aortic dimensions according to race

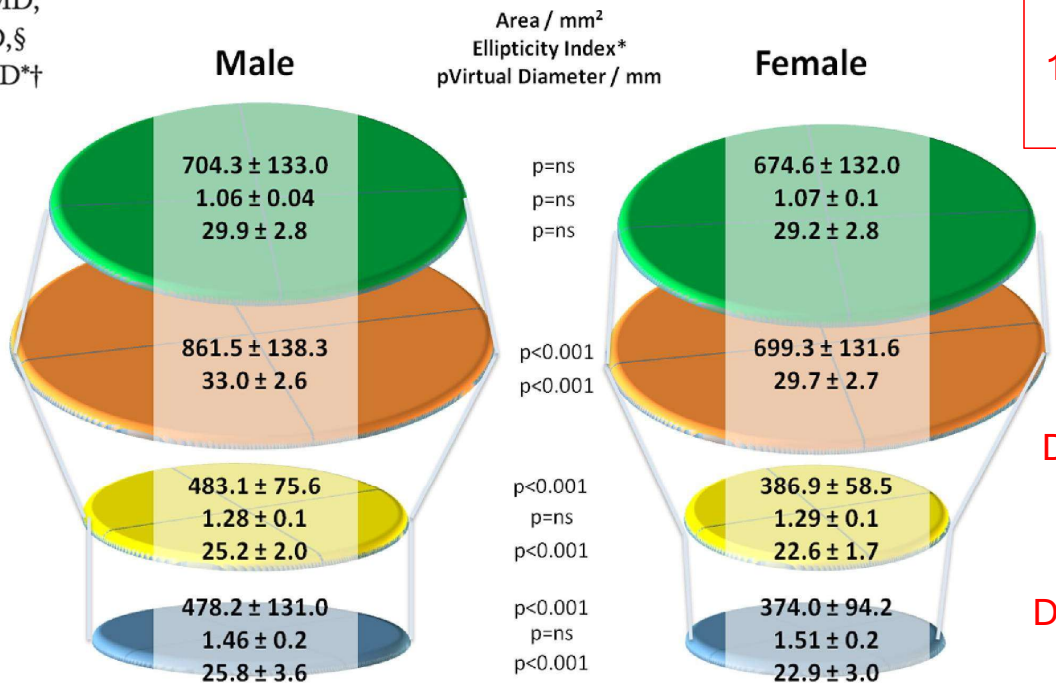
n	Asian (*n* = 790)	Black (*n* = 181)	White (*n* = 665)	*P*
BSA, m^2	1.68 ± 0.19	1.86 ± 0.22	1.84 ± 0.21	*,†,‡
Height, cm	163 ± 9	169 ± 9	171 ± 10	*,†,‡
Systolic BP, mm Hg	123.4 ± 12.0	121.5 ± 11.5	118.4 ± 12.9	*,‡
Diastolic BP, mm Hg	76.0 ± 8.5	72.7 ± 9.0	72.1 ± 8.6	*,†,‡
Aortic annular diameter, mm	20.1 ± 2.2	21.0 ± 2.2	20.4 ± 2.2	*,‡,§
BSA-indexed annular diameter, mm/m^2	11.8 ± 1.3	11.6 ± 1.4	11.3 ± 1.4	*,†,§
Height-indexed annular diameter, mm/m	12.0 ± 1.1	12.2 ± 1.0	12.2 ± 1.1	*,†
Aortic SoV diameter, mm	29.6 ± 3.8	31.3 ± 3.8	32.1 ± 3.7	*,†,‡,§
BSA-indexed aortic SoV diameter, mm/m^2	16.9 ± 2.3	17.6 ± 2.4	18.8 ± 2.8	*,†,‡,§
Height-indexed aortic SoV diameter, mm/m	17.7 ± 1.9	19.2 ± 1.9	20.3 ± 2.1	*,†,‡,§
Aortic STJ diameter, mm	25.5 ± 3.5	27.3 ± 3.6	27.6 ± 3.6	*,†,‡
BSA-indexed aortic STJ diameter, mm/m^2	14.6 ± 2.1	15.3 ± 2.2	16.2 ± 2.6	*,†,‡,§
Height-indexed aortic STJ diameter, mm/m	15.2 ± 1.7	16.6 ± 1.8	17.5 ± 2.0	*,†,‡,§

J Am Soc Echocardiogr . 2022 Mar;35(3):267-274.

Aortic Root Dimensions Among Patients With Severe Aortic Stenosis Undergoing Transcatheter Aortic Valve Replacement

Lutz Buellesfeld, MD,* Stefan Stortecky, MD,* Bindu Kalesan, PHD,† Steffen Gloekler, MD,* Ahmed A. Khattab, MD,* Fabian Nietlispach, MD,* Valentina Delfine, MD,* Christoph Huber, MD,‡ Balthasar Eberle, MD,§ Bernhard Meier, MD,* Peter Wenaweser, MD,* Stephan Windecker, MD*†





BSA 1.72/1.9 = 0.90

Diam 90%

Diam 90%

Diam 89%

J Am Coll Cardiol Intv 2013;6:72–83

Effects of Aging and Body Size on Proximal and Ascending Aorta and Aortic Arch: Inner Edge–to–Inner Edge Reference Values in a Large Adult Population by Two-Dimensional Transthoracic Echocardiography

Oana Mirea, MD, Francesco Maffessanti, PhD, Paola Gripari, MD, Gloria Tamborini, MD, Manuela Muratori, MD, Laura Fusini, MS, Cefalù Claudia, MD, Cesare Fiorentini, MD, Iancu Emil Plesea, MD, PhD, and Mauro Pepi, MD, *Milan, Italy; Craiova, Romania*

Table 2 Reference ranges for aortic measurements indexed to BSA separately for gender and age decade

	Women	Men	Women	Men
Age (y)	Aortic annulus (mm/m^2)		SoV (mm/m^2)	
<30	11.4 ± 1.1	11.4 ± 1.2	15.5 ± 1.5	15.3 ± 1.8
30–39	11.7 ± 1.0	11.4 ± 1.1	16.5 ± 1.6	15.7 ± 1.3*
40–49	11.7 ± 1.0	11.5 ± 0.9	16.8 ± 1.4	16.6 ± 1.5
50–59	12.0 ± 0.9	11.5 ± 0.9	17.9 ± 1.6	16.8 ± 1.7*
60–69	11.7 ± 1.1	12.1 ± 1.0	17.5 ± 1.7	17.8 ± 1.6
>70	11.6 ± 1.1	12.0 ± 1.0	18.2 ± 1.9	18.1 ± 1.7
All	11.7 ± 1.0	11.6 ± 1.0	17.0 ± 1.9	16.6 ± 1.8

J Am Soc Echocardiogr 2013;26:419-27

If BSA-indexed aortic dimensions are similar across sexes, why is PPM after SAVR more prevalent in women?

Aortic Root Dimensions Among Patients With Severe Aortic Stenosis Undergoing Transcatheter Aortic Valve Replacement

Lutz Buellesfeld, MD,* Stefan Stortecky, MD,* Bindu Kalesan, PHD,†
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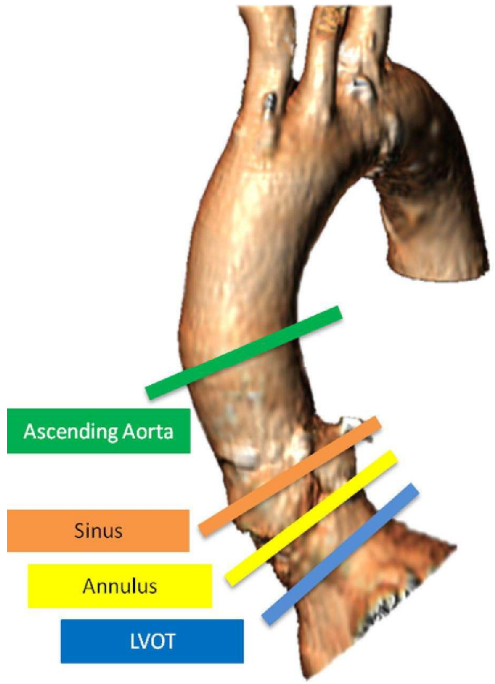
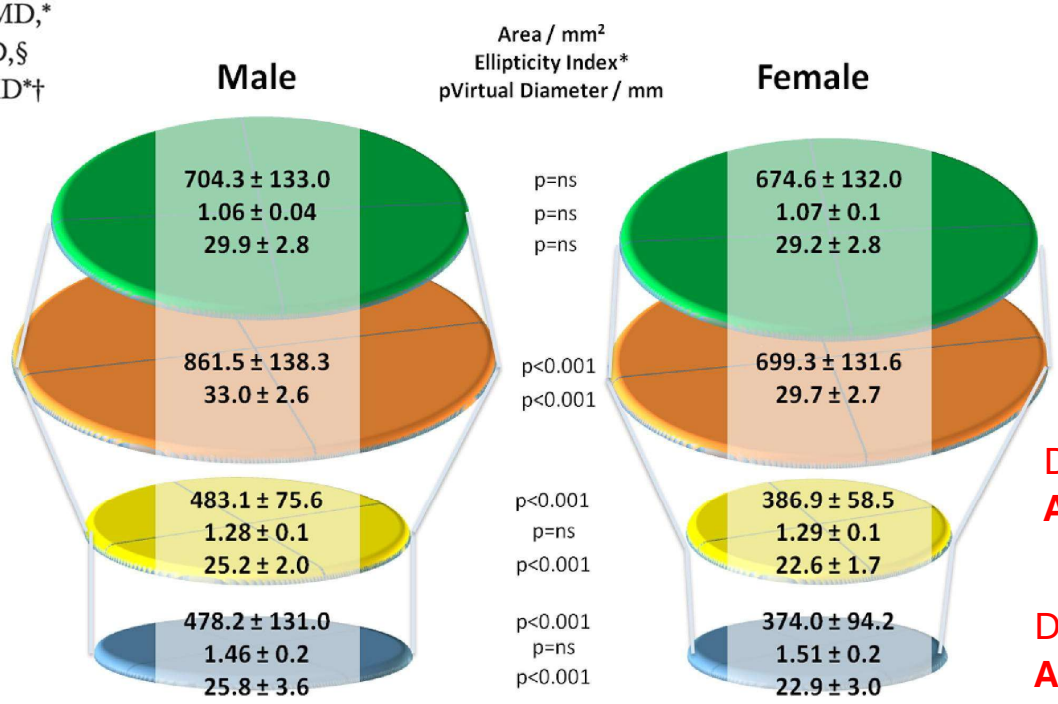




Diam 90%
Area 81%

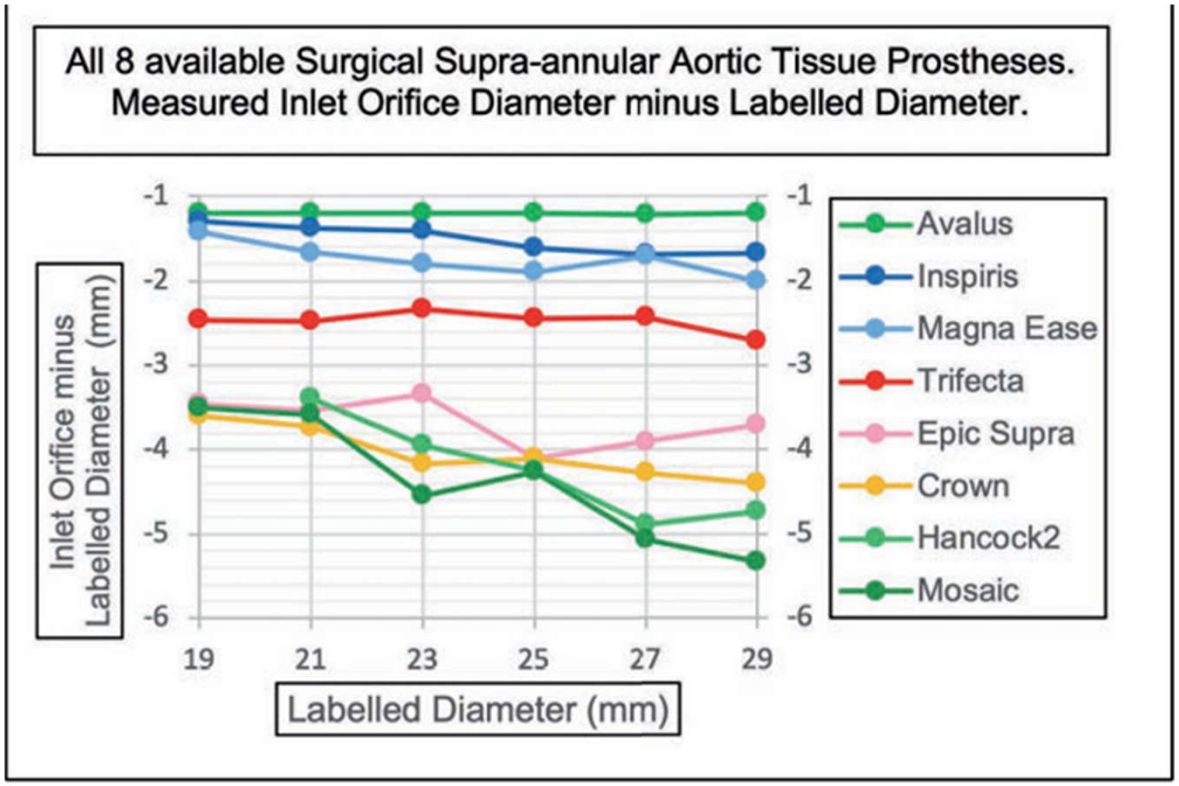
Diam 90%
Area 80%

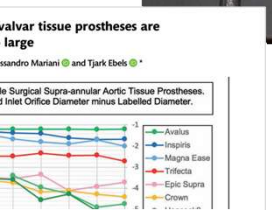
Diam 89%
Area 78%

J Am Coll Cardiol Intv 2013;6:72–83

All surgical supra-annular aortic valvar tissue prostheses are labelled too large

Astrid Gerritje Maria van Boxtel , Massimo Alessandro Mariani and Tjark Ebels *





Interdisciplinary CardioVascular and Thoracic Surgery 2023, 36(6), ivad076

Labelled size (mm)	Inflow orifice diameter (mm)	Correct labelled size (mm)	Label oversized by percent
Abbott Epic Supra			
19	*15.9*	*16*	*20%*
21	*17.7*	*18*	*18%*
23	19.7	20	17%
25	21.4	21	17%
27	23.1	23	17%
29	25.3	25	15%
Abbott Trifecta			
19	16.5	17	15%
21	18.5	19	13%
23	20.7	21	11%
25	22.6	23	11%
27	24.6	25	10%
29	26.3	26	10%

Labelled size (mm)	Inflow orifice diameter (mm)	Correct labelled size (mm)	Label oversized by percent
Edwards Inspiris			
19	17.7	18	7%
21	19.6	20	7%
23	21.6	22	6%
25	23.4	23	7%
27	25.4	25	6%
29	27.3	27	7%
Edwards Magna Ease			
19	17.6	18	8%
21	19.3	19	9%
23	21.6	22	7%
25	23.4	23	7%
27	25.3	25	7%
29	27.0	27	7%

Interdisciplinary CardioVascular and Thoracic Surgery 2023, 36(6), ivad076

Labelled size (mm)	Inflow orifice diameter (mm)	Correct labelled size (mm)	Label oversized by percent
Medtronic Avalus			
19	17.8	18	7%
21	19.8	20	6%
23	21.8	22	6%
25	23.8	24	5%
27	25.8	26	5%
29	27.8	28	4%
Medtronic Mosaic			
19	15.5	15	23%
21	17.4	17	21%
23	18.5	18	25%
25	20.7	21	21%
27	21.9	22	23%
29	*23.7*	*24*	*25%*

Effective orifice diameter: a new sizing parameter of surgical valve prostheses to inform valve selection

Changfu Wu[1], Chad Green[2], Salvador Marquez[3], Paolo Monelli[4], Craig Weinberg[5], Matthew Weston[6], Patricia Lawford[7], Duke Cameron[8], Ajit Yoganathan[9], Ulrich Steinseifer[10]

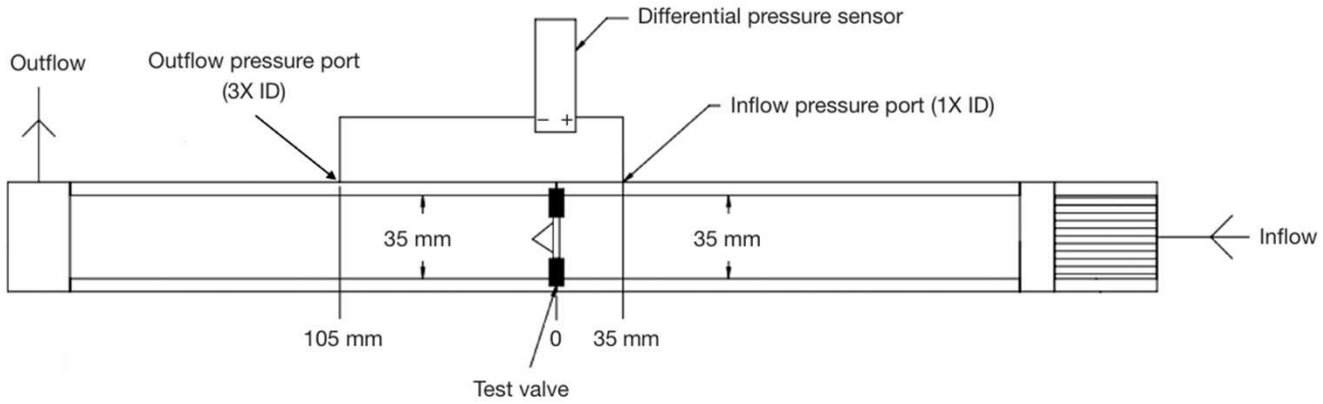


Figure 1 Diagram of a generic steady flow tester. ID, internal diameter (of the straight tube).

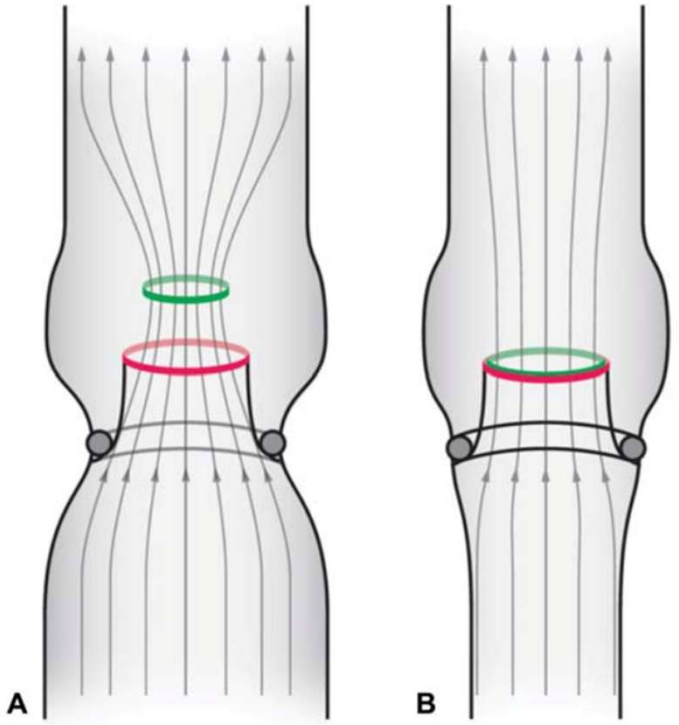
Ann Cardiothorac Surg. 2024 May 31;13(3):283-290

Labeled Diameter	Mean EO diameter (mm)	EOD-LAD	% label oversized
Epic			
21	11.5	-9.5	82.6%
25	15.1	-9.9	65.6%
29	17	-12	70.6%
Trifecta			
19	16	-3	18.8%
21	17.5	-3.5	20.0%
25	21.5	-3.5	16.3%
Mitroflow			
23	15.1	-7.9	52.3%
27	18.4	-8.6	46.7%
29	20.9	-8.1	38.8%
MagnEase			
19	14.9	-4.1	27.5%
23	17	-6	35.3%
29	23.1	-5.9	25.5%
31	24	-7	29.2%
Avalus			
21	15.4	-5.6	36.4%
25	17.5	-7.5	42.9%
27	20.9	-6.1	29.2%
Mosaic			
19	12.5	-6.5	52.0%
23	16.2	-6.8	42.0%
27	18.5	-8.5	45.9%

Limitations in the Assessment of Prosthesis-Patient Mismatch

Paulo A. Amorim , Mahmoud Diab , Mario Walther , Gloria Färber , Andreas Hagendorff , Robert O. Bonow , Torsten Doenst

♀:♂ **0.78 LVOT area**



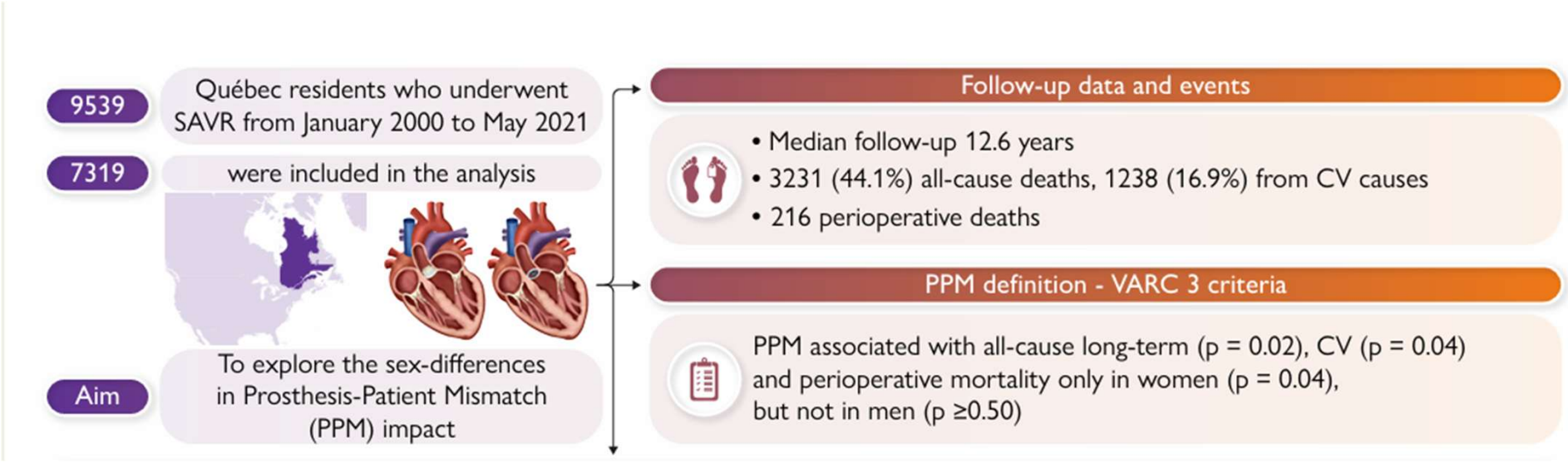
Thorac Cardiovasc Surg 2020;68:550–556

ESC European Society of Cardiology
European Heart Journal (2025) **46**, 2320–2332
https://doi.org/10.1093/eurheartj/ehaf076

CLINICAL RESEARCH
Valvular heart disease

Sex-related differences in prosthesis-patient mismatch after surgical aortic valve replacement and long-term outcomes

Paolo Springhetti, Kathia Abdoun, Éric Dumont, François Dagenais, Dimitri Kalavrouziotis, Siamak Mohammadi, Philippe Pibarot, and Marie-Annick Clavel *



Circ 2024;150:Suppl_1:A4144744

Circulation Journal
doi:10.1253/circj.CJ-22-0718

ORIGINAL ARTICLE

Association of Valve Size and Hemodynamic Performance With Clinical Outcomes in Aortic Valve Replacement

— A Long-Term Follow-up in an Asian Population —

Yi Yen, MD; Kuo-Chun Hung, MD; Yi-Hsin Chan, MD;
Victor Chien-Chia Wu, MD; Yu-Ting Cheng, MD; Chia-Pin Lin, MD;
Jih-Kai Yeh, MD; Pao-Hsien Chu, MD; Shao-Wei Chen, MD, PhD

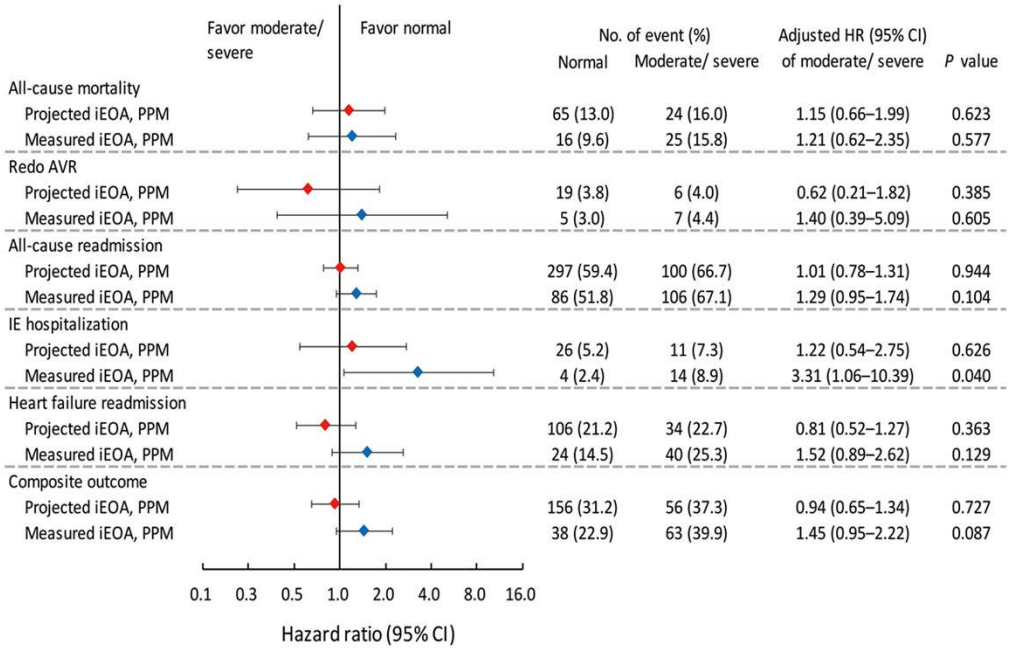
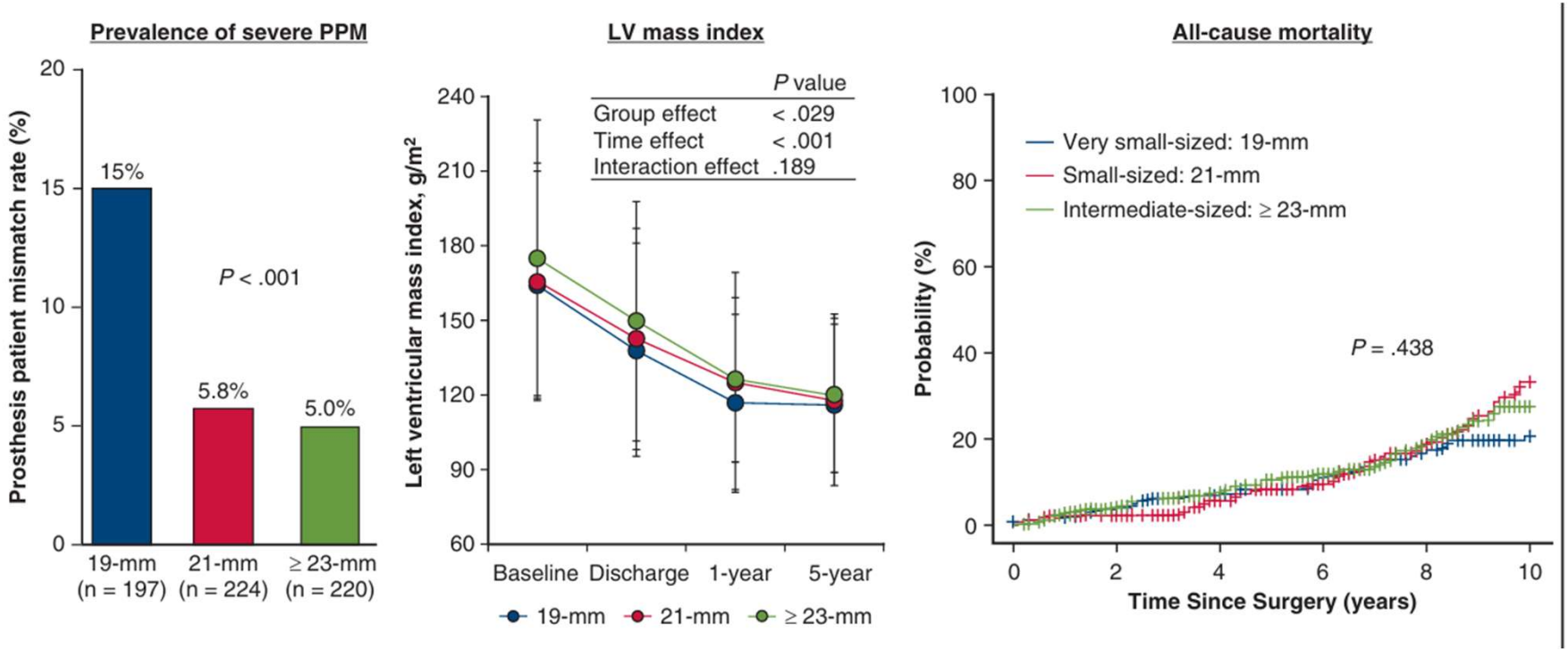


Figure 3. Adjusted association between projected indexed effective orifice area (EOAi), measured EOAi, and risk of clinical events. CI, confidence interval; HR, hazard ratio; PPM, prosthesis-patient mismatch.

ADULT: AORTIC VALVE · Volume 171, Issue 3, P578-589.E2, March 2026

Prognostic influence of biological valve size on long-term outcomes of primary surgical aortic valve replacement for aortic stenosis

Rieko Kutsuzawa, MD [a] · Satoshi Kainuma, MD, PhD [a] · Naonori Kawamoto, MD, PhD
Kazuhiro Yamamoto, MD, PhD [b] · Takashi Daimon, PhD [c] · Satsuki Fukushima, MD, PhD [a] ...



J Thorac Cardiovasc Surg. 2026 Mar;171(3):578-589.e2

ORIGINAL RESEARCH

American Heart Association | American Stroke Association

Thoracic Aortic Aneurysm Growth: Role of Sex and Aneurysm Etiology

Katie Cheung; Munir Boodhwani, MD; Kwan-Leung Chan, MD; Luc Beauchesne, MD; Alexander Dick, MD; Thais Coutinho, MD

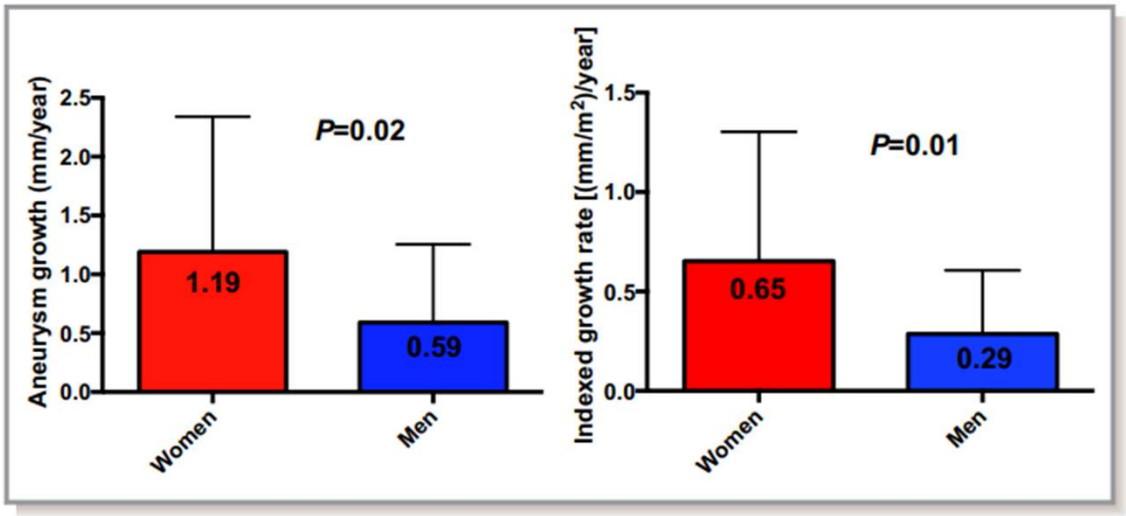


Figure 2. Aneurysm growth rates in men and women. Absolute (left) and indexed (right) aneurysm growth rates were over twice as fast in women as in men.

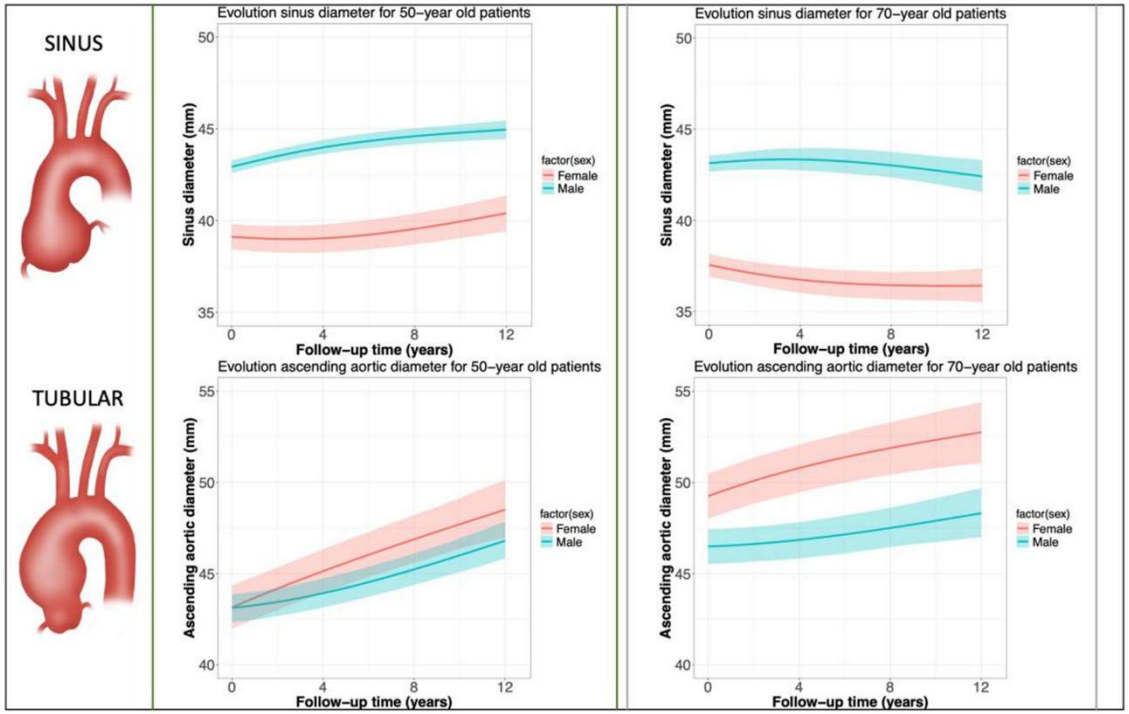
J Am Heart Assoc. 2017;6:e003792

ESC European Society of Cardiology
European Heart Journal (2025) **46**, 551–564
https://doi.org/10.1093/eurheartj/ehae525

CLINICAL RESEARCH
Cardiac and vascular surgery

Sex-related differences in the clinical course of aortic root and ascending aortic aneurysms: the DisSEXion Study

Maximiliaan L. Notenboom [1†], Adine R. de Keijzer [1†], Kevin M. Veen [1], Arjen Gökalp [1], Ad J.J.C. Bogers [1], Robin H. Heijmen [2], Roland R.J. van Kimmenade [3], Guillaume S.C. Geuzebroek [2], M. Mostafa Mokhles[4], Jos A. Bekkers [1], Jolien W. Roos-Hesselink [5], and Johanna J.M. Takkenberg [1*]



2022 ACC/AHA Guideline for the Diagnosis and Management of Aortic Disease: A Report of the American Heart Association/American College of Cardiology Joint Committee on Clinical Practice Guidelines

2a	**C-LD**	6. In patients with a height >1 standard deviation above or below the mean who have an asymptomatic aneurysm of the aortic root or ascending aorta and a maximal cross-sectional aortic area/height ratio of ≥10 cm^2/m, surgery is reasonable when performed by experienced surgeons in a Multidisciplinary Aortic Team.[14,15,22]
2b	**C-LD**	7. In asymptomatic patients with aneurysms of the aortic root or ascending aorta who have either an ASI of ≥3.08 cm/m^2 or AHI of ≥3.21 cm/m, surgery may be reasonable when performed by experienced surgeons in a Multidisciplinary Aortic Team.[23]

Circulation Journal
Circ J 2023; **87:** 1410–1621
doi:10.1253/circj.CJ-22-0794

JCS/JSCVS/JATS/JSVS 2020 Guideline on Diagnosis and Treatment of Aortic Aneurysm and Aortic Dissection

Table 12. COR and LOE of Open Surgery for Unruptured Aneurysms of the Aortic Root/Ascending Aorta

	COR	LOE
Open surgery is recommended for asymptomatic non-dissecting aneurysm, IMH, PAU, infected aneurysm, or pseudoaneurysm with ≥55 mm in maximum diameter or even those <55 mm if the enlargement rate is ≥5 mm/6 months[384]	I	C
Marfan syndrome (See **Table 49**)		
Open surgery is recommended when the maximum diameter is ≥50 mm[536]	I	C
Open surgery should be considered when the maximum diameter is ≥45 mm and there are risk factors for aortic dissection* [536]	IIa	C
Prophylactic open surgery should be considered in women expecting pregnancy if the maximum diameter is ≥40 mm[537]	IIa	C
Open surgery may be considered if the maximum diameter is 40–45 mm and there are risk factors for aortic dissection* [536]	IIb	C
Aortic aneurysm associated with bicuspid aortic valve (See **Table 52**)		
Open surgery is recommended when the maximum diameter is ≥55 mm[538–542]	I	C
Open surgery should be considered when the maximum diameter is ≥50 mm if it is performed at an experienced facility for patients with a familial history of aortic dissection, an enlargement rate of ≥5 mm/6 months, and low surgical risk[538,539,543]	IIa	C
In performing aortic valve surgery in patients with severe aortic valve stenosis or insufficiency, simultaneous replacement of the aortic root/ascending aorta should be considered when the maximum diameter is ≥45 mm[544–548]	IIa	C

Conclusions

- Absolute differences in aortic root dimensions exist by sex and by race
- Indexing appears to eliminate sex-related differences
- PPM may be influenced by valve design and differing biologic responses rather than annular size alone
- Aortic aneurysm growth and complications seem to differ by sex but there is limited data