Central Corneal Thickness in the Ocular Hypertension Treatment Study (OHTS)

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Ocular Hypertension Treatment Study (OHTS)

- The OHTS is a prospective, randomized, multi-center trial designed to determine whether the medical lowering of IOP in patients with ocular hypertension is safe and effective in delaying or preventing the development of primary open-angle glaucoma
- In the OHTS, patients are randomly assigned to medical treatment or close observation

Ocular Hypertension Treatment Study (OHTS)

Entry Criteria

- Age 40 - 80
- Normal VFs
- Normal Optic Discs
- Untreated IOP:
  - 24 - 32 mmHg in qualifying eye
  - 21 - 32 in fellow eye

OHTS Demographics

- Enrollment complete in 10/96
- 1,636 subjects at 23 clinical centers
- 409 (25%) African-American

Corneal Thickness & IOP

- Goldmann applanation assumes a corneal thickness (CT) of 500 µM
- Argus (1995) demonstrated that CT was greater in ocular hypertensives than in either normals or POAG patients
- Herndon (1997) measured CT in 184 eyes:
  - 561 ± 26 µM among normals
  - 554 ± 22 µM among POAG patients
  - 606 ± 41 µM among ocular hypertensives ($p<0.001$)

Aims of Present Study

- Describe the corneal thickness of the subjects enrolled in the OHTS
- Determine if corneal thickness is related to:
  - Race
  - IOP
  - Age
  - Gender
  - Medical status (e.g., diabetes, hypertension)

Methods

- Matching ultrasonic pachymeters provided to each clinical center
- 5 measurements of central corneal thickness from each eye
- Data transmitted to OHTS Coordinating Center (St. Louis)

DGH-500 Pachette™

Methods

Quality Control

- Repeat measurements required for inter-eye difference ≥ 40 µM
- Repeat measurements in 63 subjects at one site (UC Davis) to determine test-retest reliability

Data Analysis

- One eye randomly chosen from each subject
- SAS v6.0
  - T-test and Pearson correlations
  - Multivariate general linear analysis

Results

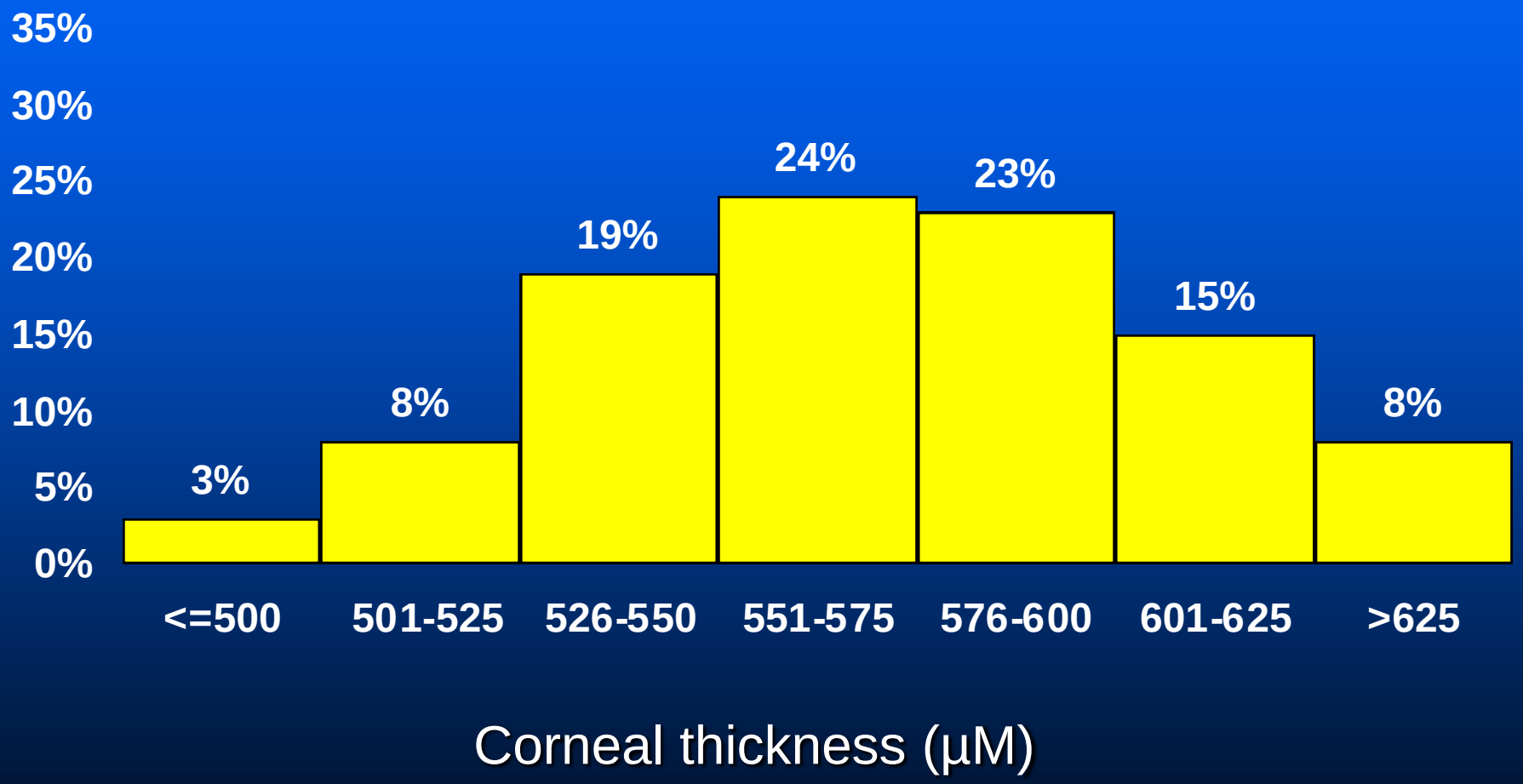
- 1,099 (69%) of OHTS subjects have undergone corneal thickness measurements as of 8/30/2000
- High data quality
  - 0.9% with inter-eye difference ≥40 μM
  - (Repeat) - (initial measurement) = 11.0 ± 13.7 μM
- 1,094 measurements available for analysis

Results

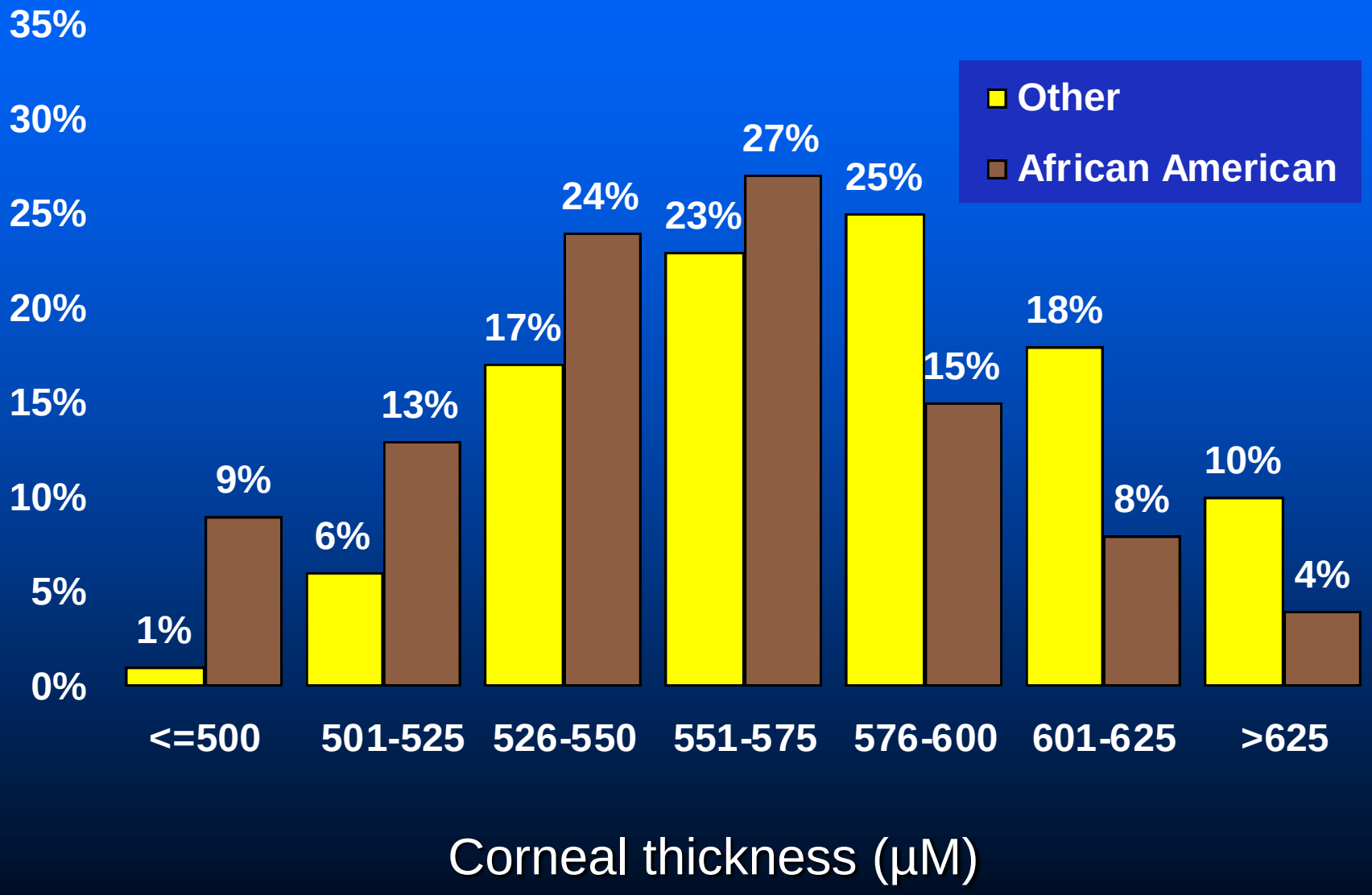
	African-American	Others	All
Male	N = 85 548.2 ± 42.4 µM	N = 375 574.1 ± 36.8 µM	N = 460 569.3 ± 39.2 µM
Female	N = 188 557.3 ± 38.6 µM	N = 446 582.0 ± 36.0 µM	N = 634 574.7 ± 38.7 µM
All	N = 273 554.5 ± 40.0 µM	N = 821 578 ± 37.0 µM	N = 1,094 572.4 ± 39.0 µM

Difference between African-American and 'Others' subjects $p<0.0001$

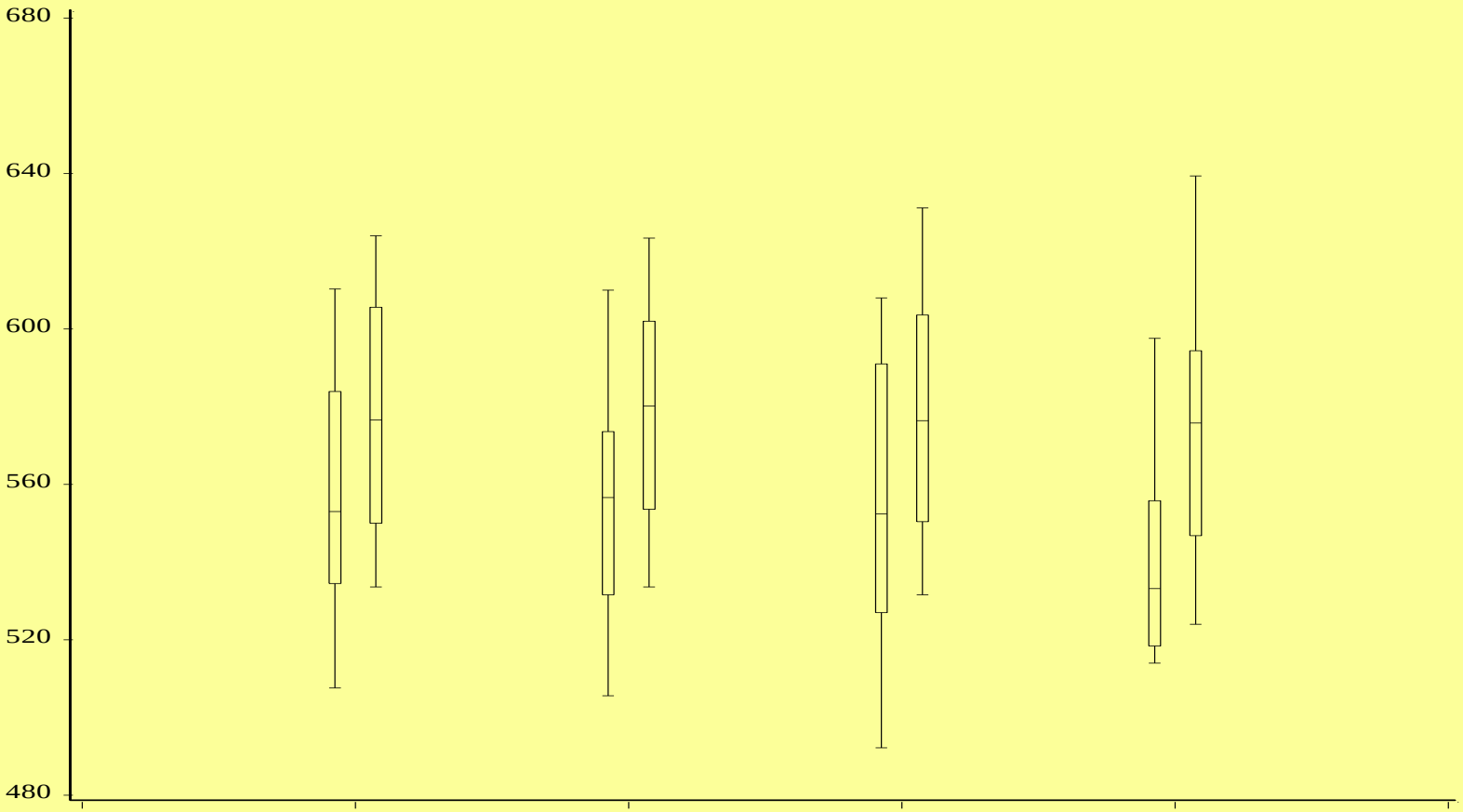
Distribution of Corneal Thickness
(all OHTS subjects)



Corneal Thickness by Race



Corneal Thickness vs. Baseline IOP



	<=24		25-27		28-30		>30	
	Af-Am	Oth	Af-Am	Oth	Af-Am	Oth	Af-Am	Oth
N=	120	353	89	301	47	130	17	37
75 %tile	583.9	605.6	573.6	602	591	603.6	555.8	594.4
Median	553	576.6	556.6	580.2	552.4	576.4	533.2	575.8
25 %tile	534.5	550	531.6	553.6	527	550.4	518.4	546.8

Other Relationships

- Baseline refraction (N = 1,090)
  - r = -0.09, p = 0.0018
- Gender
  - Female 574.7 ± 38.7 µM; Male 569.3 ± 39.2 µM (p = 0.02)
- Diabetes
  - Diabetic (N = 117): 580.2 ± 42.0 µM
  - Non-diabetic (N = 974): 571.5 ± 38.5 µM (p = 0.02)
- Age at time of measurement
  - r = -0.16, p < 0.001

Multivariate Analysis

- The multivariate model included race, gender, age at testing, baseline refraction, baseline IOP, baseline medical history and the interaction of race with gender, systemic hypertension and diabetes
- Significant relationships
  - Race ($p < 0.001$)
  - Age ($p < 0.0001$)
  - Gender ($p = 0.014$)
  - Diabetes ($p = 0.0016$)
- Baseline refraction, Baseline IOP, systemic hypertension and the racial interactions were not statistically significant in the multivariate model

What is "Normal" Corneal Thickness?

- A recent meta-analysis* of the corneal thickness literature found that mean corneal thickness of 'normal' eyes is 534 µM
  - 530 µM for optical pachometry
  - 544 µM for ultrasonic pachymetry
- Our study demonstrates that subjects in the OHTS have increased corneal thickness (572.4 ± 39 µM)

* Doughty & Zaman (2000)

Survey of Ophthalmology 44:367-408

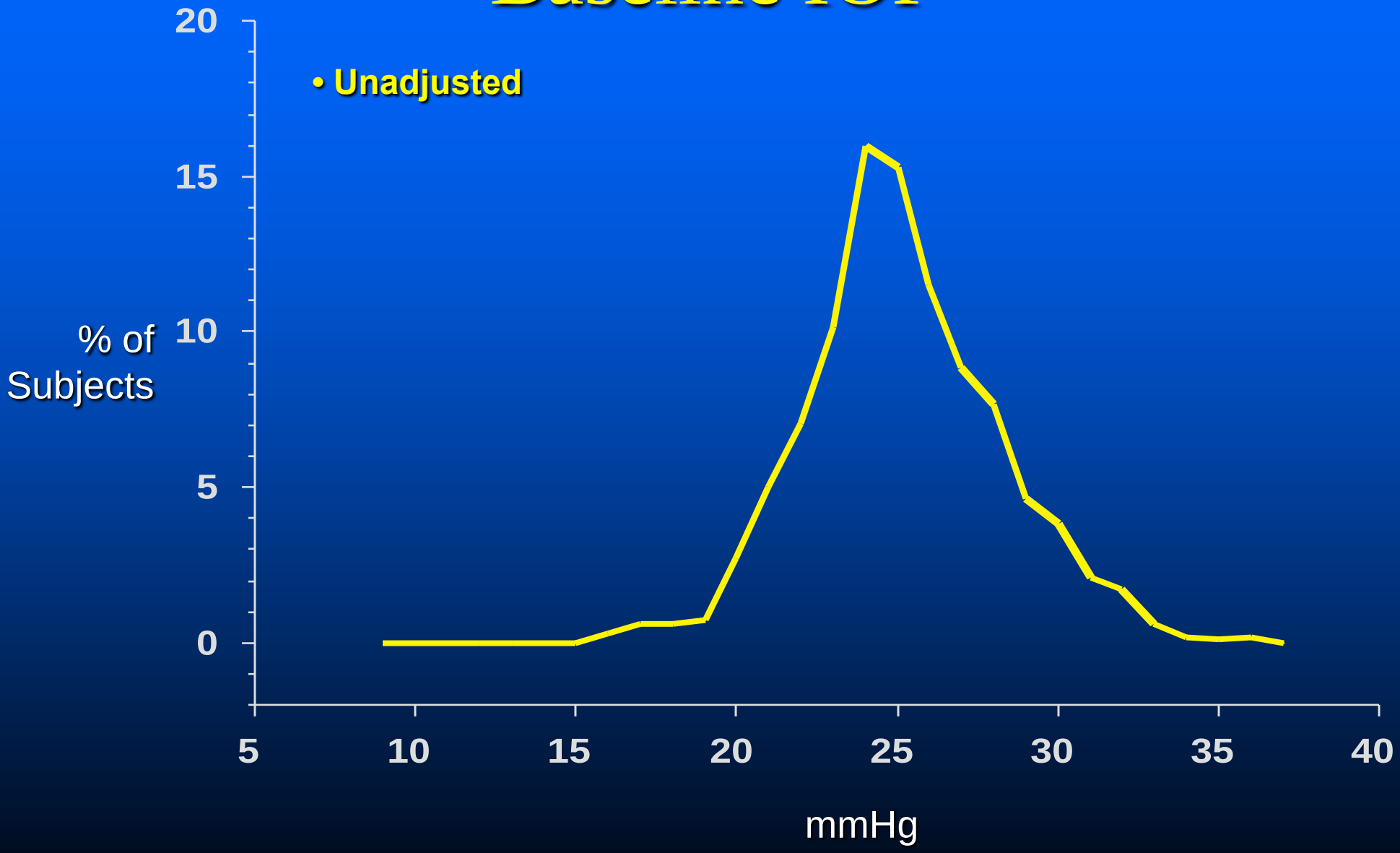
Race and Corneal Thickness

- Most previous studies of corneal thickness have been performed in racially homogeneous populations
- Foster (1998) found thinner corneas (495 µM) in a Mongolian population
- Our study demonstrates that African-American OHTS subjects have thinner corneas than their ‘others’ counterparts

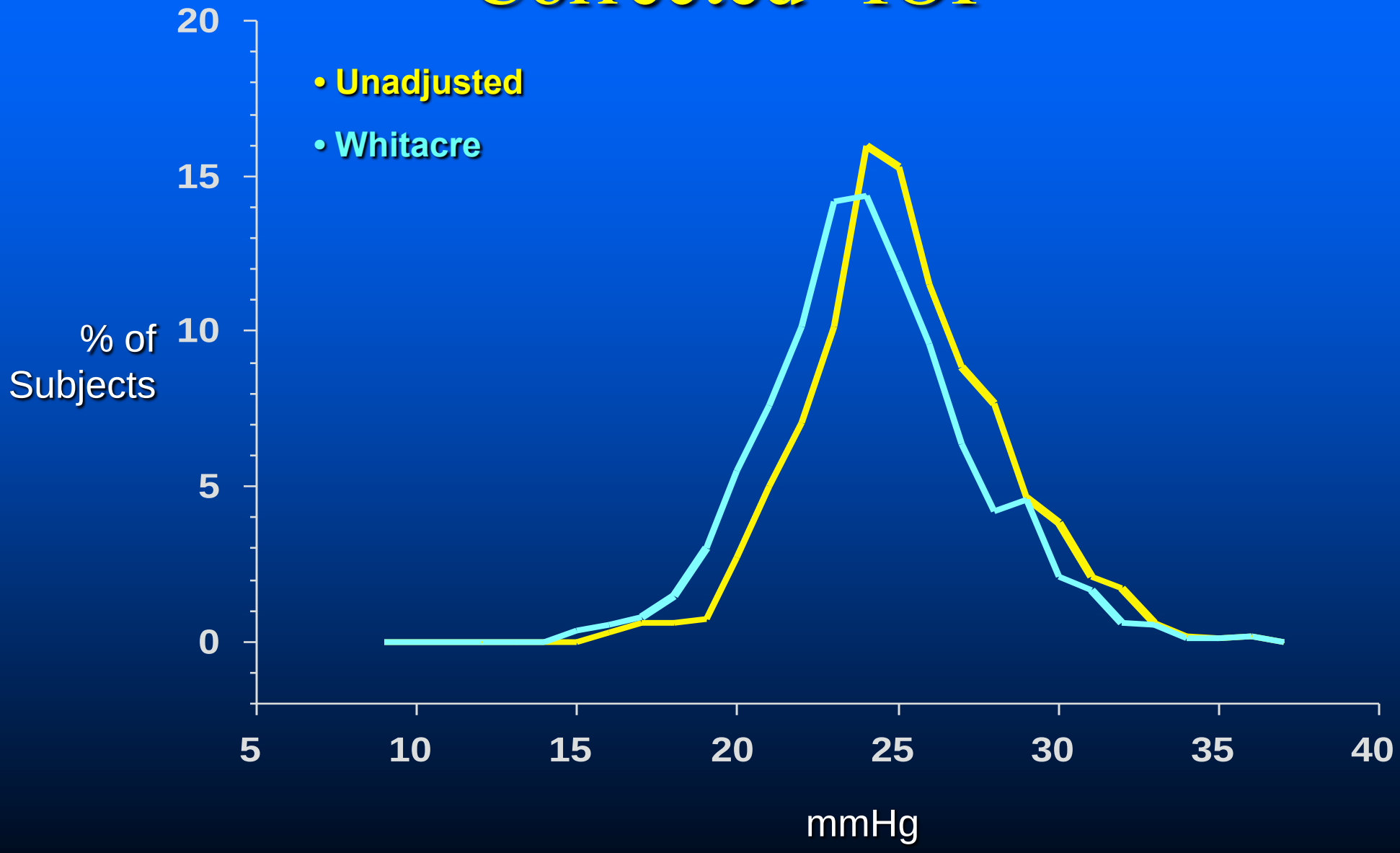
Correcting IOP for Corneal Thickness

- Ehlers (1975) cannulated 29 eyes undergoing cataract surgery
  - 5 mmHg/70 µM
- Doughty & Zaman (2000) meta-analysis
  - 2.5 mmHg/50 µM
- Whitacre (1993) and the Rotterdam Eye Study (1997)
  - 2.0 mmHg/100 µM

Baseline IOP



“Corrected” IOP



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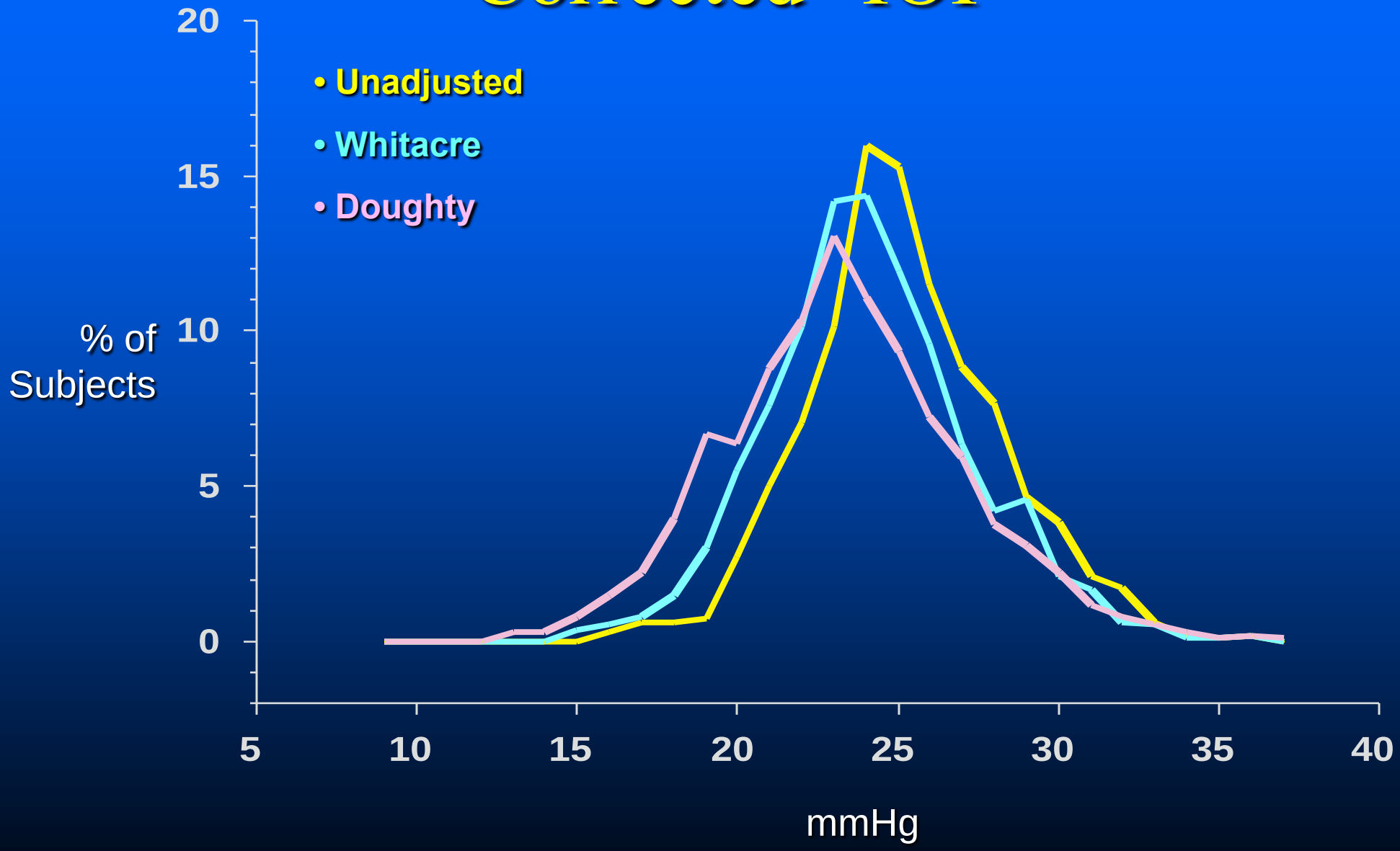
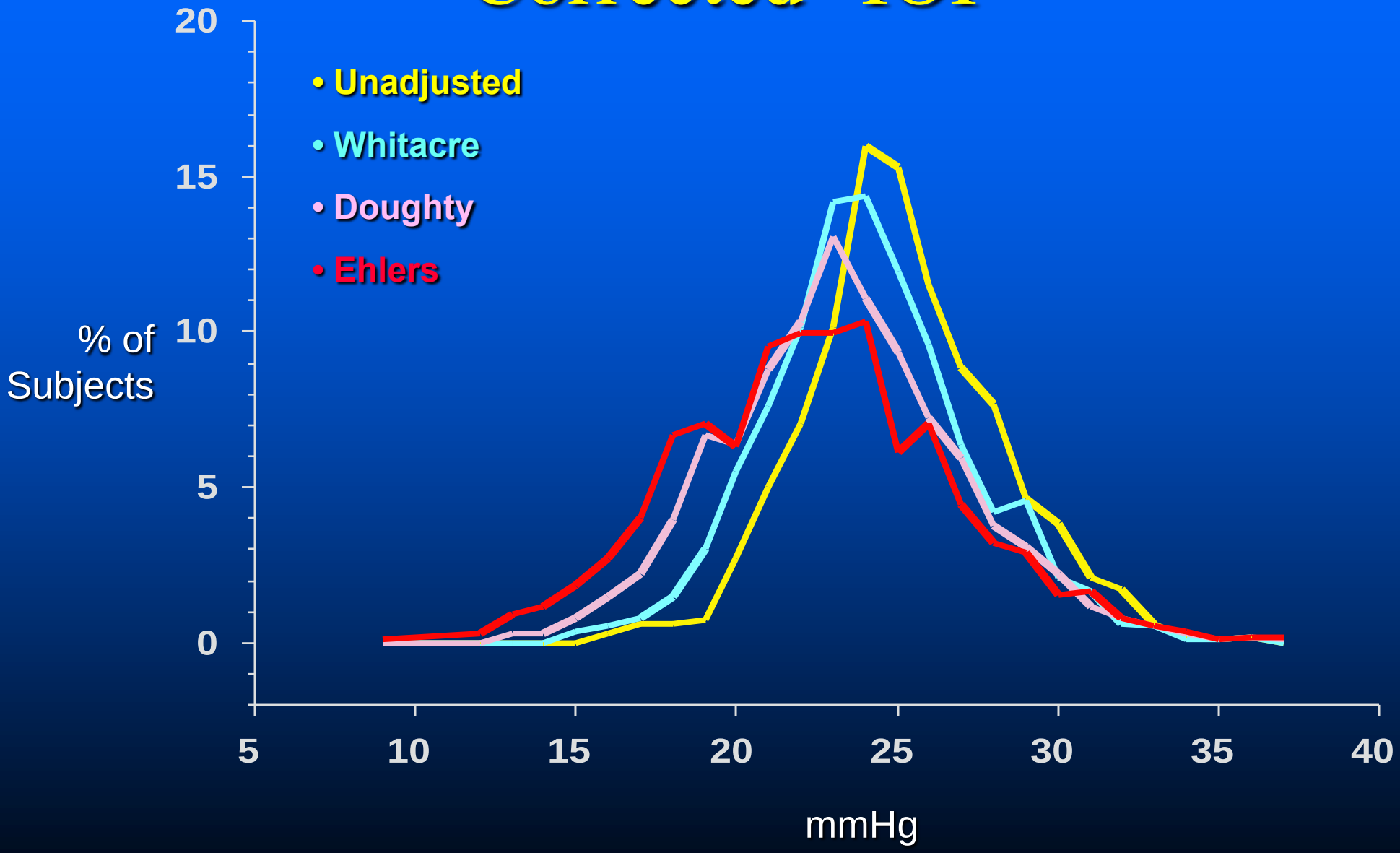


“Corrected” IOP



Clinical Significance

- 45 % of ‘others’ had a ‘corrected’ IOP < 21 mmHg
- 27.5% of African-American subjects had a ‘corrected’ IOP < 21 mmHg
- If we choose an arbitrary cutoff of 600 µM, above which corneal thickness affects applanation IOP measurement to a clinically significant degree, then:
  - 28 % of ‘Others’ had corneal thickness > 600 µM
  - 12% of African Americans had corneal thickness > 600 µM

Conclusions

- OHTS subjects have *thicker* corneas than ‘normal’ subjects
- African-American OHTS subjects have *thinner* corneas than their ‘others’ counterparts
- Corneal thickness must be considered in the development of any risk model for ocular hypertensive patients

OHTS Clinical Centers

- Bascom Palmer Eye Institute
- Baylor Eye Clinic
- Charles R. Drew University
- Devers Eye Institute
- Emory University Eye Center
- Eye Associates of Washington, DC
- Eye Consultants of Atlanta
- Eye Doctors of Washington
- Eye Physicians and Surgeons of Atlanta
- Glaucoma Care Center
- Great Lakes Ophthalmology
- Henry Ford Hospitals
- Johns Hopkins University
- Jules Stein Eye Institute, UCLA
- Kellogg Eye Center
- Kresge Eye Institute
- Krieger Eye Institute
- Maryland Center for Eye Care
- Mayo Clinic/Foundation
- New York Eye & Ear Infirmary
- Ohio State University
- Salus University
- Scheie Eye Institute
- University of California, Davis
- University of California, San Diego
- University of California, San Francisco
- University of Louisville
- University Suburban Health Center
- Washington Eye Physicians & Surgeons
- Washington University, St. Louis

OHTS Resource Centers

Study Chairman's Office
&
Coordinating Center
Washington University
St. Louis, MO

Optic Disc Reading Center
Bascom Palmer Eye Institute
University of Miami
Miami, FL

Visual Field Reading Center
University of California, Davis
Sacramento, CA