Perspectives on the Utility of BMI Standards for Children: Universal Standards?

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Introductory Remarks

- 1.) Perspectives on the title
- 2.) Defining Obesity and recognizing it
- 3.) Current definitions
- Underweight $< 5^{th}$ %ile BMI
- Normal weight $=>5^{th} < 85^{th}$
- At risk of overweight $=>85^{th} < 95^{th}$
- Overweight $=>95th$

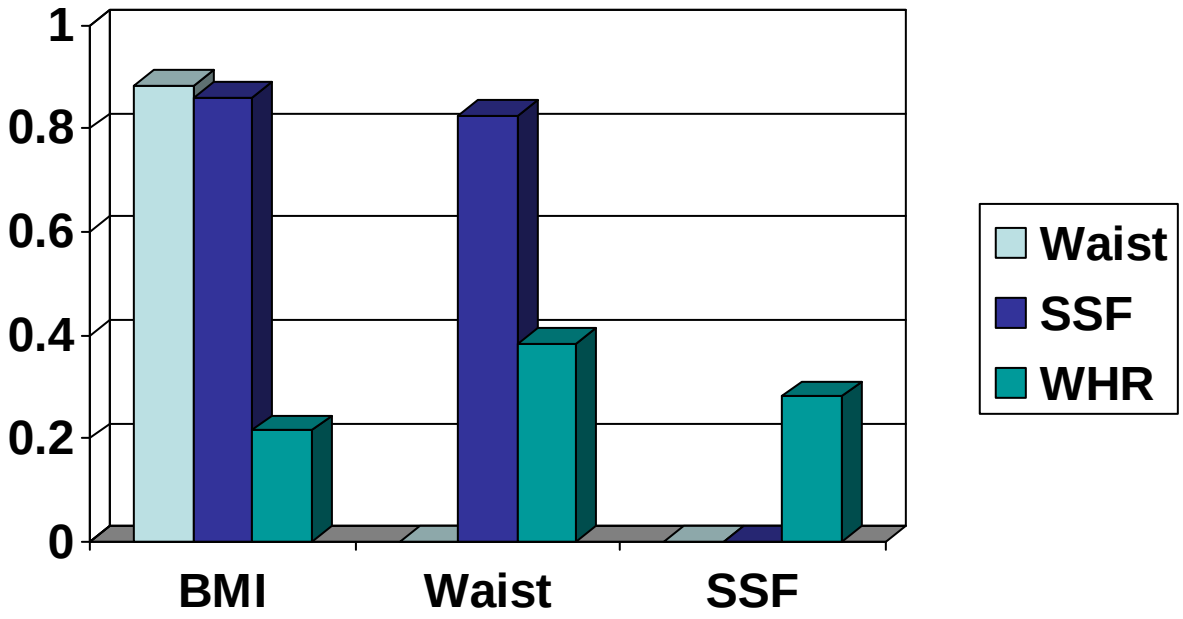
Evaluating Body Composition Measures

- The measures should:
- 1.) be easy for the subjects.
- 2.) be easy for staff.
- 3.) be relatively quick and inexpensive.
- 4.) have low technical error.
- 5.) associate with relevant factors.
- 6.) have abundant published data for comparability.

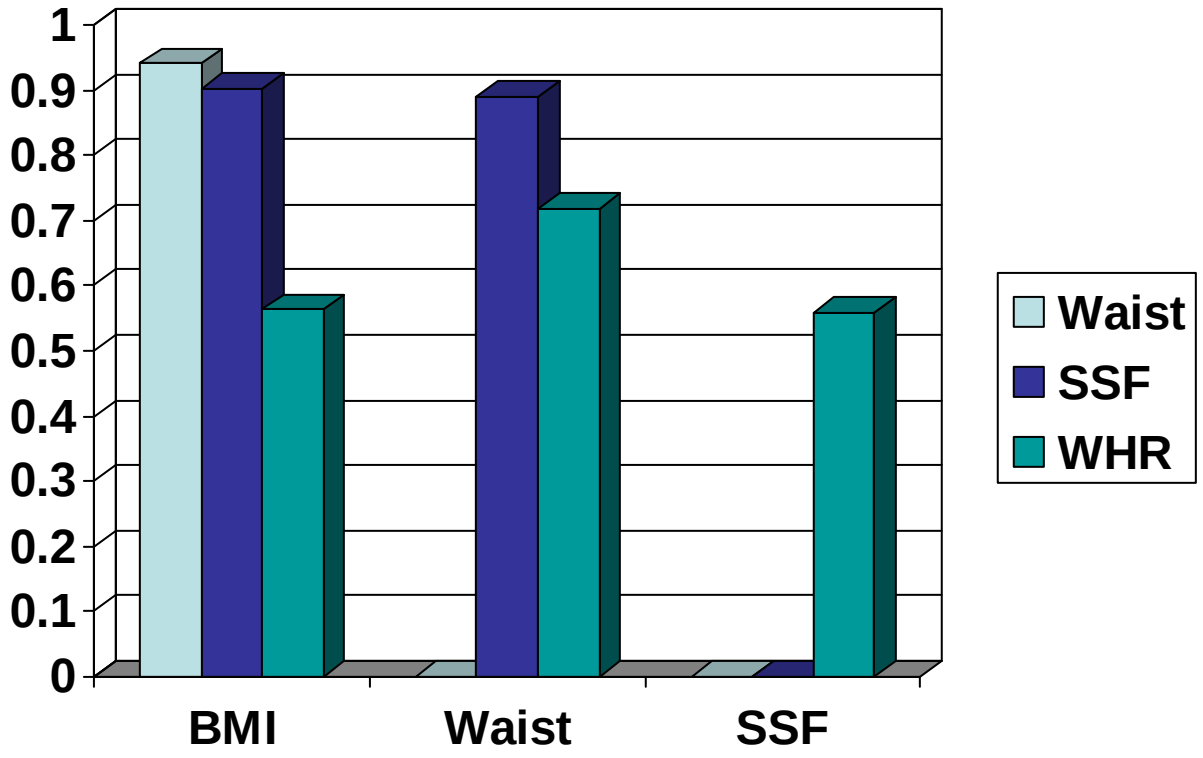
Intended Use(s) of the Data

- Clinical and Epidemiological Uses of data
- Clinical- must make Tx decisions
- “To treat or not” - requires cutoffs
- Epidemiological-
- may use cutoffs or assess continuous relationships

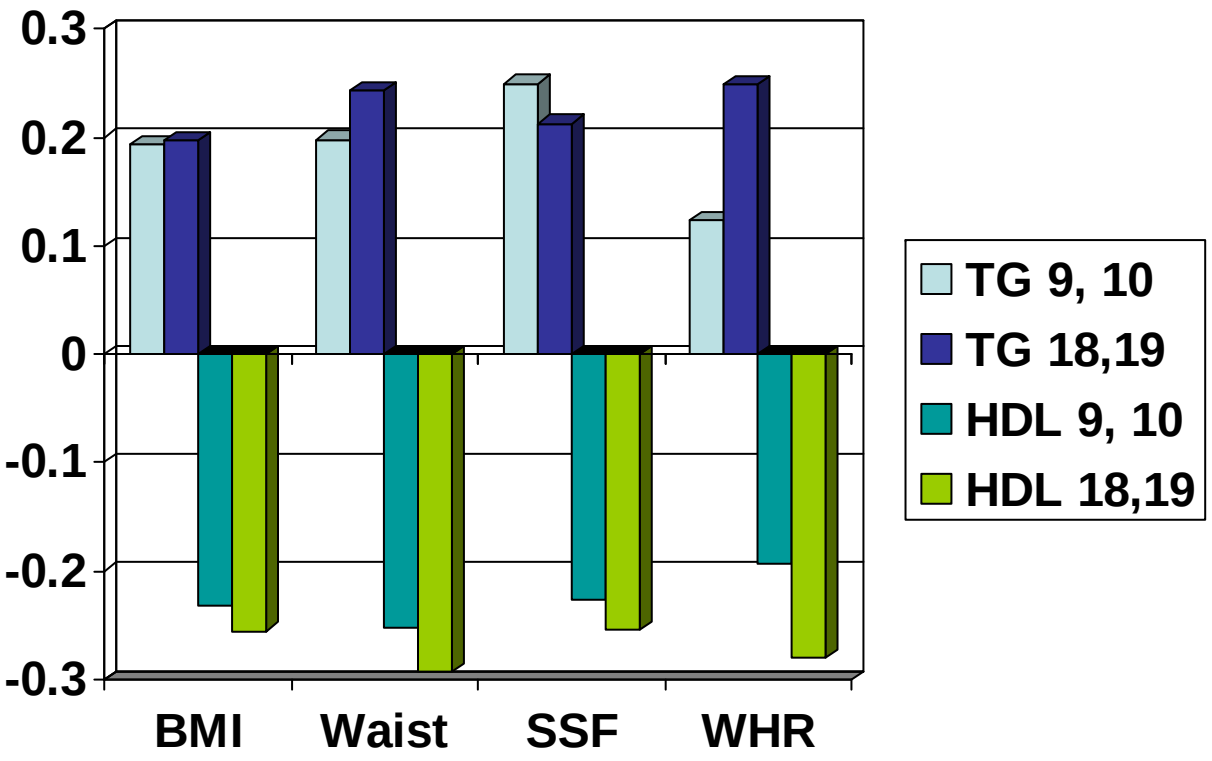
Inter Index Correlations Age 9, 10



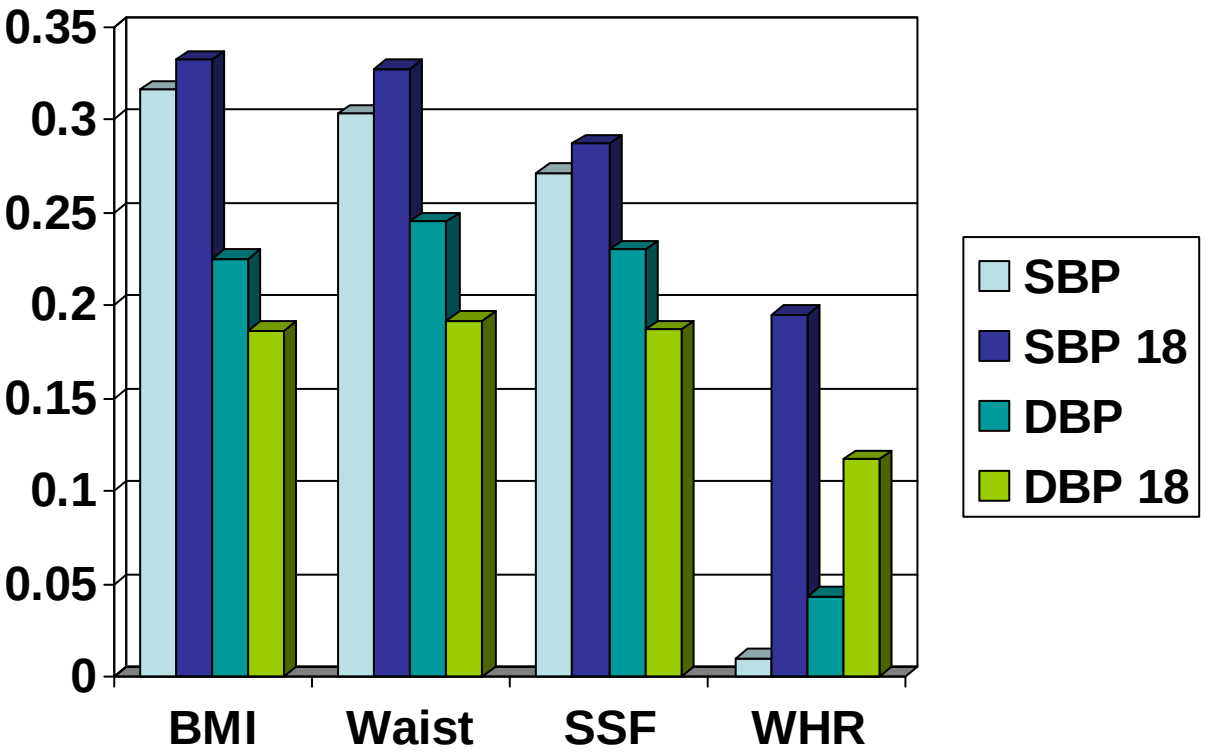
Inter-Index Correlations of Indices, Ages 18, 19



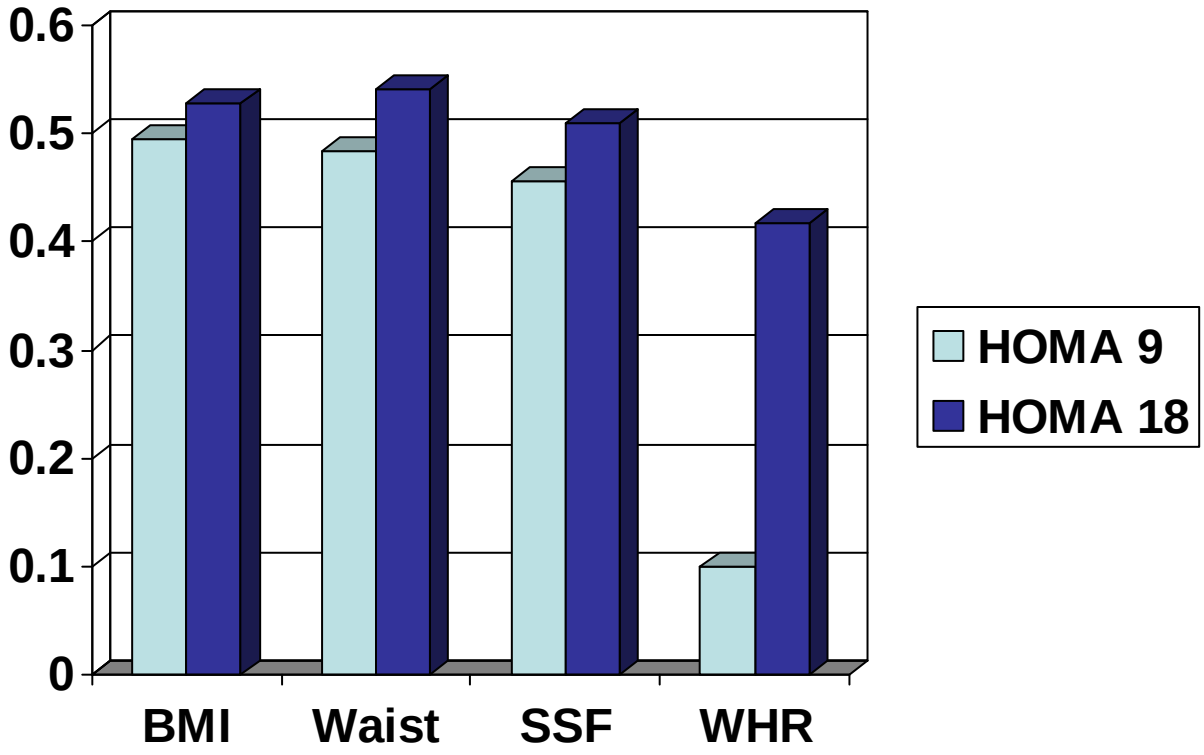
Body Composition-Lipid Correlations, By Age



Obesity-BP Correlations by Age



Body Comp-HOMA IR Correlations by Age



OR, 95% CI, AUR, and Goodness of Fit from Logistic Regressions Predicting IR, Ages 18, 19

Index	Units	O.R.	95%CI	AUR	G-of-F
BMI	Kg/m*2	1.174	1.14-1.20	0.812	0.49
Waist	1.0 cm	1.096	1.08-1.11	0.827	0.36
SSF	1.0 mm	1.036	1.029-1.043	0.795	0.58
WHR	0.01	1.2	1.157-1.244	0.774	0.33

OR, 95 % CI, AUR and Goodness of Fit from Logistic Regressions Predicting IFG, age 18, 19

Index	Units	O.R.	95% CI	AUR	G-of-F
BMI	kg/m*2	1.08	1.05-1.12	0.689	>0.5
Waist	1.0 cm	1.04	1.02-1.06	0.679	>0.9
SSF	1.0mm	1.01	1.006-1.11	0.655	0.057
WHR	0.01	1.07	1.024-1.12	0.605	> 0.9

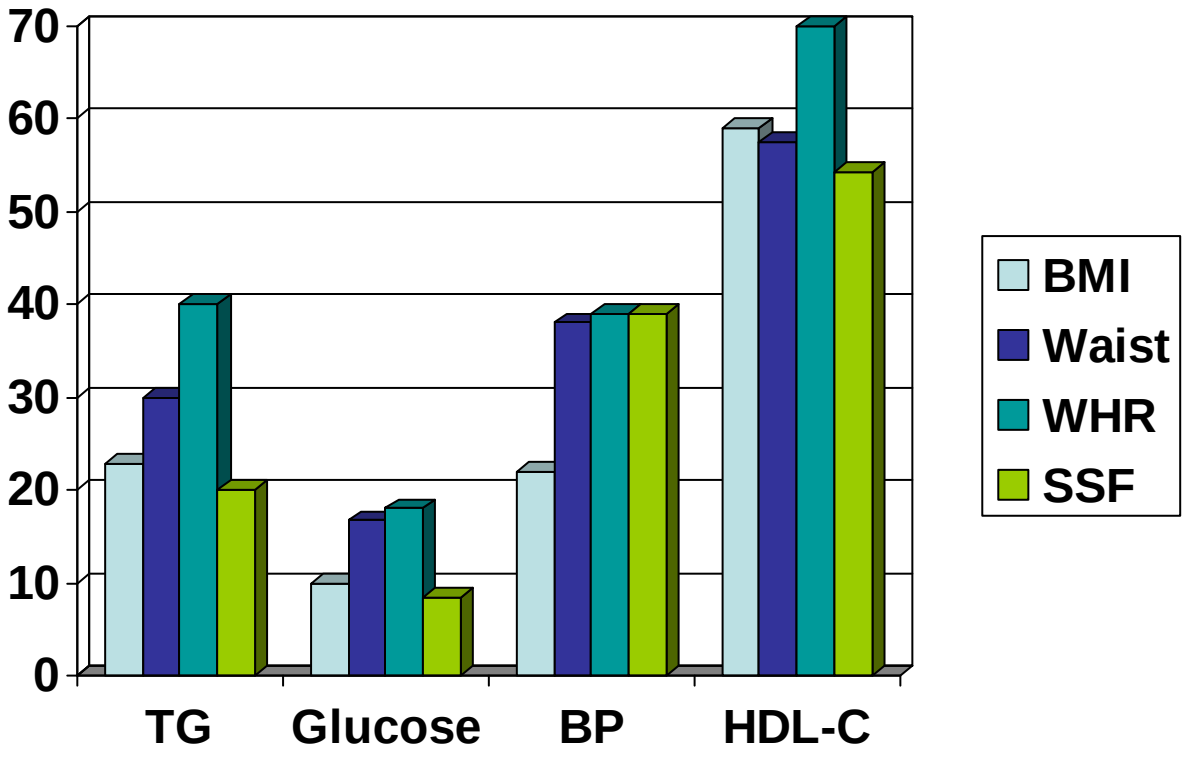
WAIT!!

- All preceding comparisons have used correlation analyses to compare the associations of the indices and factors as continuous variables.
- What if we impose cutoffs, say the 95th % for the index and the 90th % for the factor. Do the indices associate same with factors?

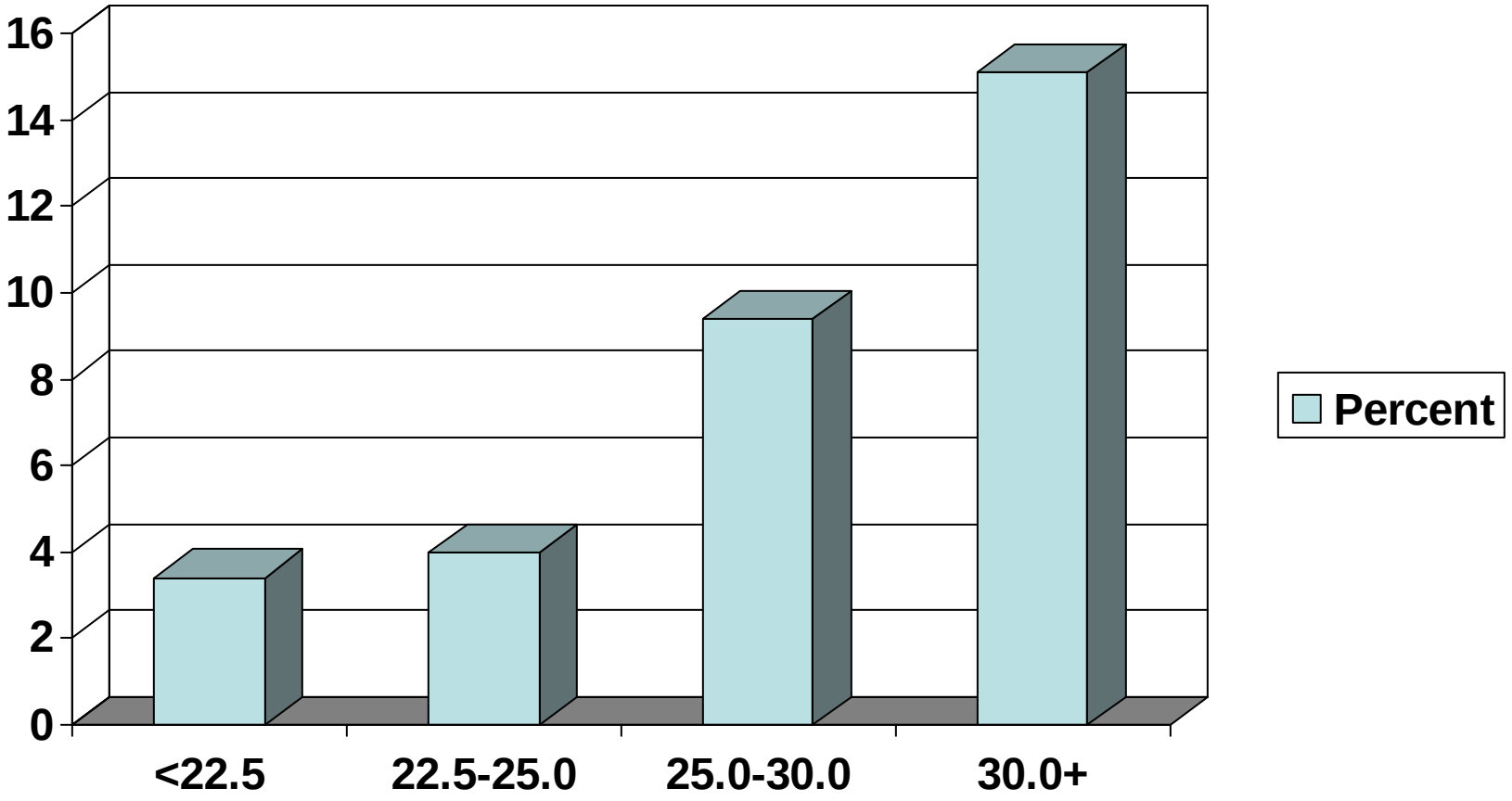
Percent of Subjects with Elevated Index Who Are Elevated by Other Indices, Age 9,10

- The agreement between overwt and top 5 % category for other indices was fair: of overwt Ss 26% did not have top 5% waist, 80% did not have top 5% WHR and 73% not top 5% SSF.
- Of girls with top 5% waist, 63% did not have top 5% WHR;
- of girls with top 5% SSF , 72% did not have top 5% WHR

% Subjects With Elevated Obesity Index with High TG, SBP, Glucose, and Low HDL-C, Ages 18, 19



Percent Prevalence of IFG by BMI category in NGHS girls at Ages 18, 19



Racial Differences / Similarities

- The preceding comparisons have used ALL NGHS Ss (B & W combined) in the analyses evaluating indices.

- The other question I want to address involves ethnic differences. Do the obesity indices work equally well for different ethnic groups? Does race affect the associations?

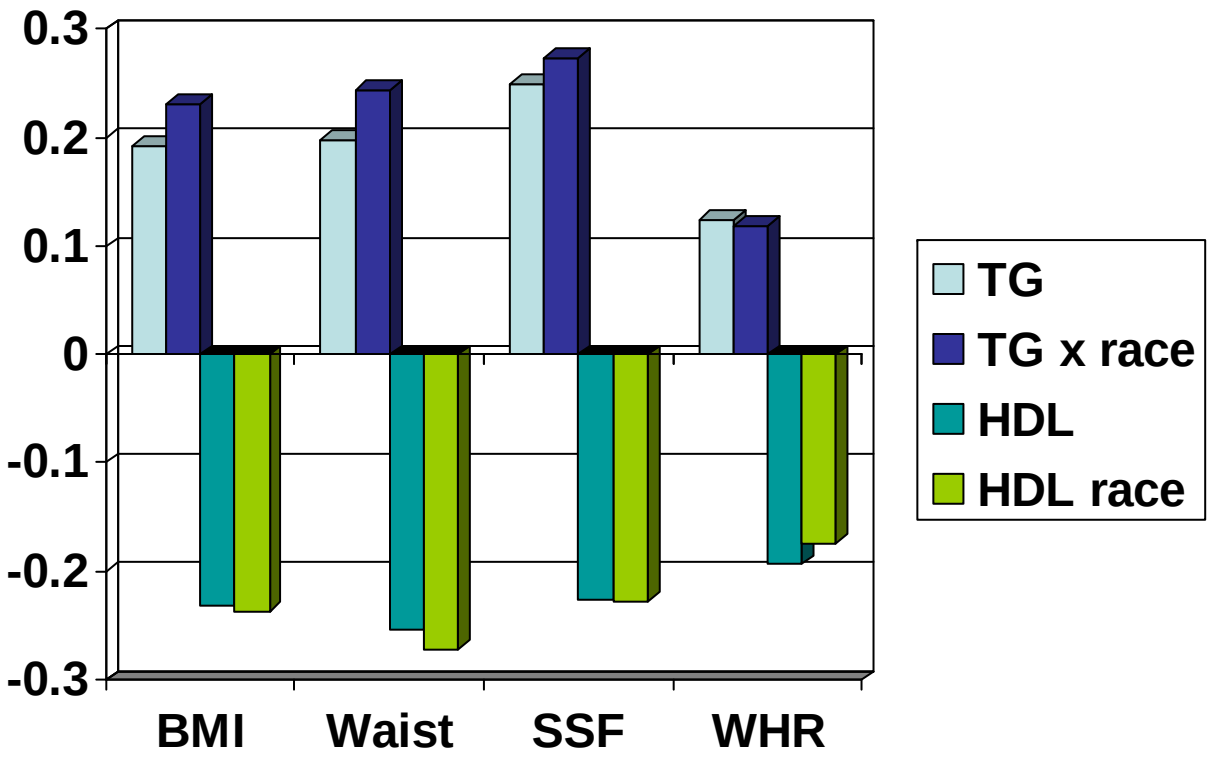
Comments on Ethnic Differences

- The WHO expert consultation's report on appropriate body mass index for Asians reported: 1) high prevalence of T2DM & CVD in pop'ns with mean BMI < 25; 2) the association of BMI x fatness different.

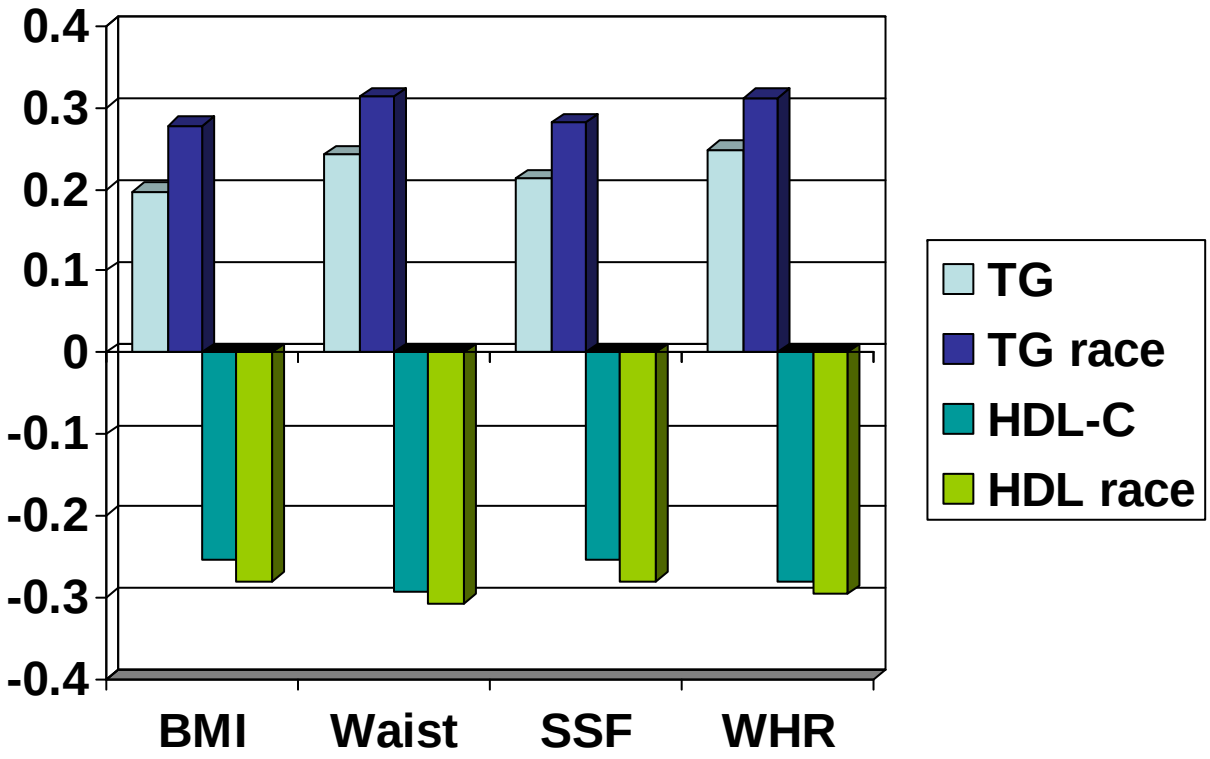
- Within this context, I offer the following data.

- For my first look, I used partial correlations with the previous correlations

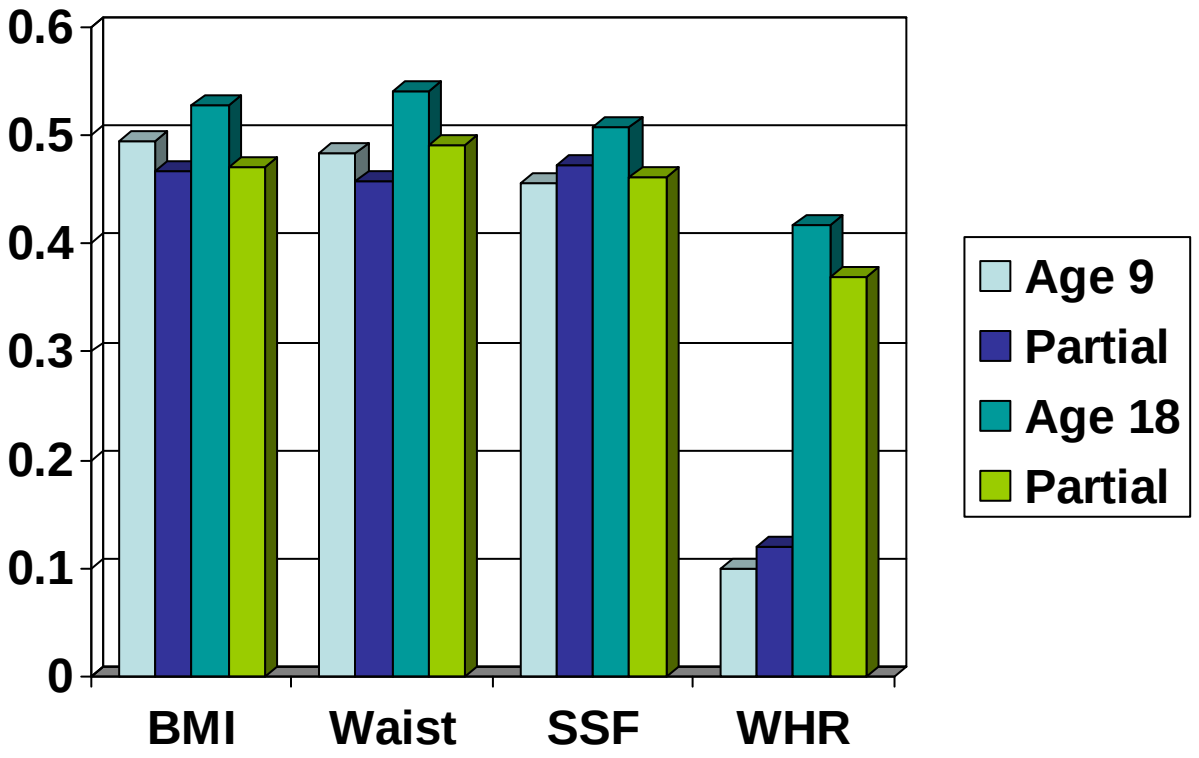
Simple and Partial Correlations for Body Comp x Lipids, Age 9, 10



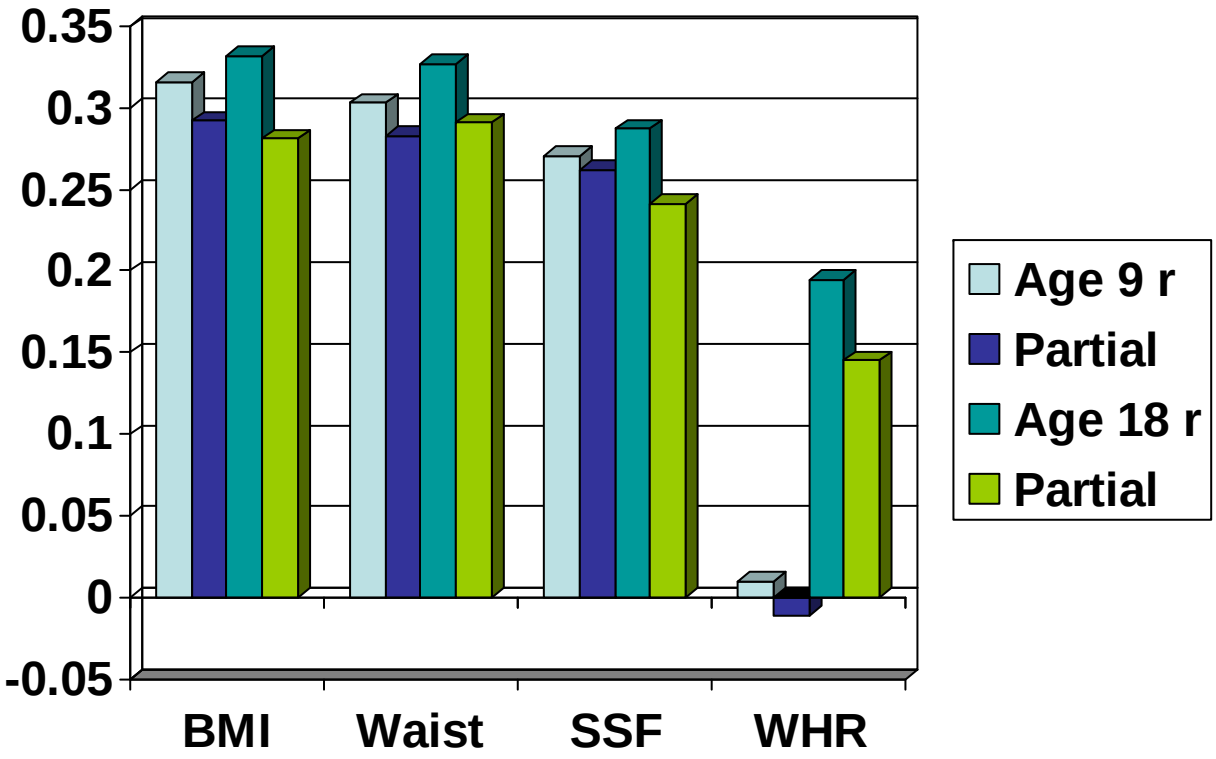
Simple and Partial Correlations for Body Comp x Lipids, Age 18, 19



Simple and Partial (race) Correlations by Age for HOMA IR and Obesity



Simple and Partial (race) Correlations for SBP-Obesity , by Age



Regression of SBP on BMI, Race, Race * BMI

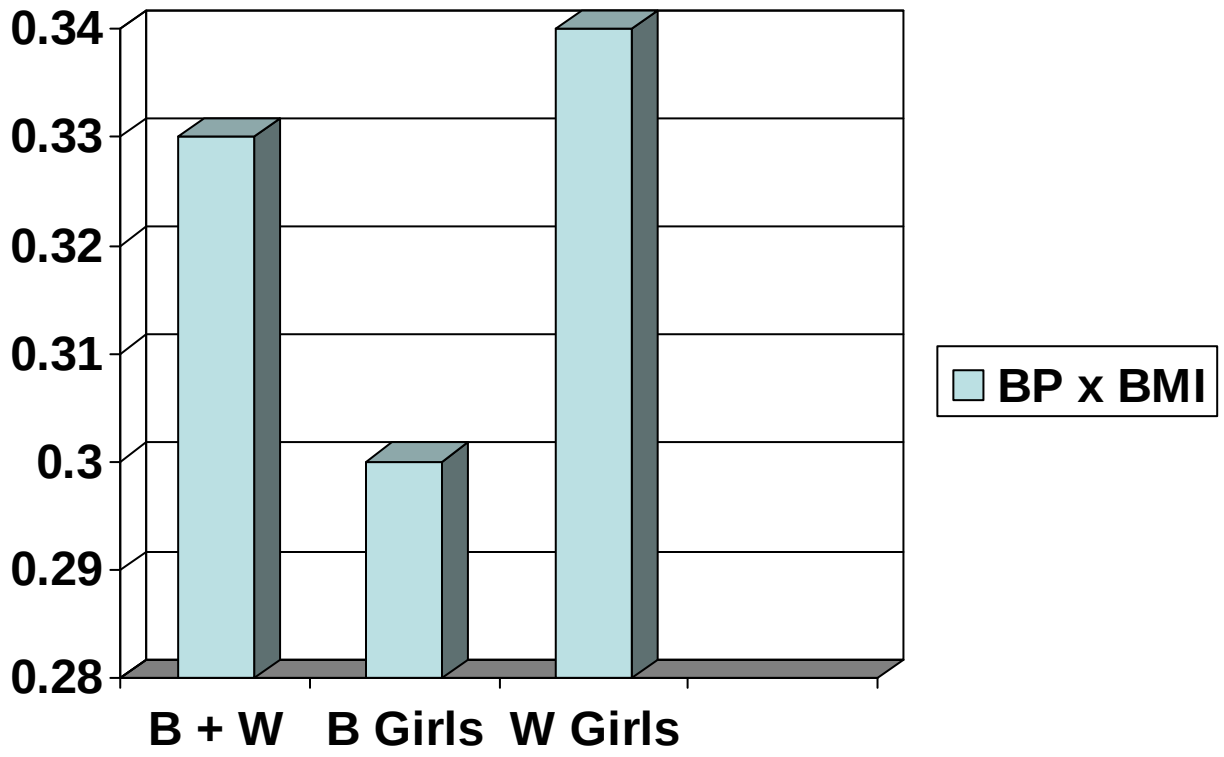
- Results showed that BMI alone was significant.. Not Race and not BMI x Race

- Because race term is dichotomous, we ran separate Eqns and to control for effects of extreme values, we used robust regression

Race Specific Robust Regressions of SBP on BMI

- W SBP = 94 + (0.56 x BMI)
- B SBP = 98.5 + (0.41 x BMI)
- Conclusion: BG start higher, rise less as BMI increases

BMI - SBP Correlations, Ages 18, 19, by Race



Summary to this Point

- WHR correlations with risk factors weak at age 9, stronger at 18…
- Little to choose between BMI, Waist, SSF
- Race modestly affects correlations, yet we know that there are significant race differences in body comp indices and in risk factors ... What to say?

Ancillary Study of LBM in Black and White Girls, Ages 6-17 (Cinti NGHS)

- With DXA as std measure of LBM, we developed prediction Eqns with BIA/Anthro as indep vars
- Final Eqns used S*2/R + Xc + weight with R*2 of 0.97 and 0.99 in B and W girls
- Eqns cross-validated on other sample
- (Am J Hum Bio 1994)

Beta Coefficients (SE) for S*2/R as Predictor of FFM in B W Girls

Race	Beta Coefficient	SE (b)
White Girls	0.5076	0.04
Black Girls (Am J Hum Bio, 1994)	0.6266	0.04

Summary of Ancillary Findings

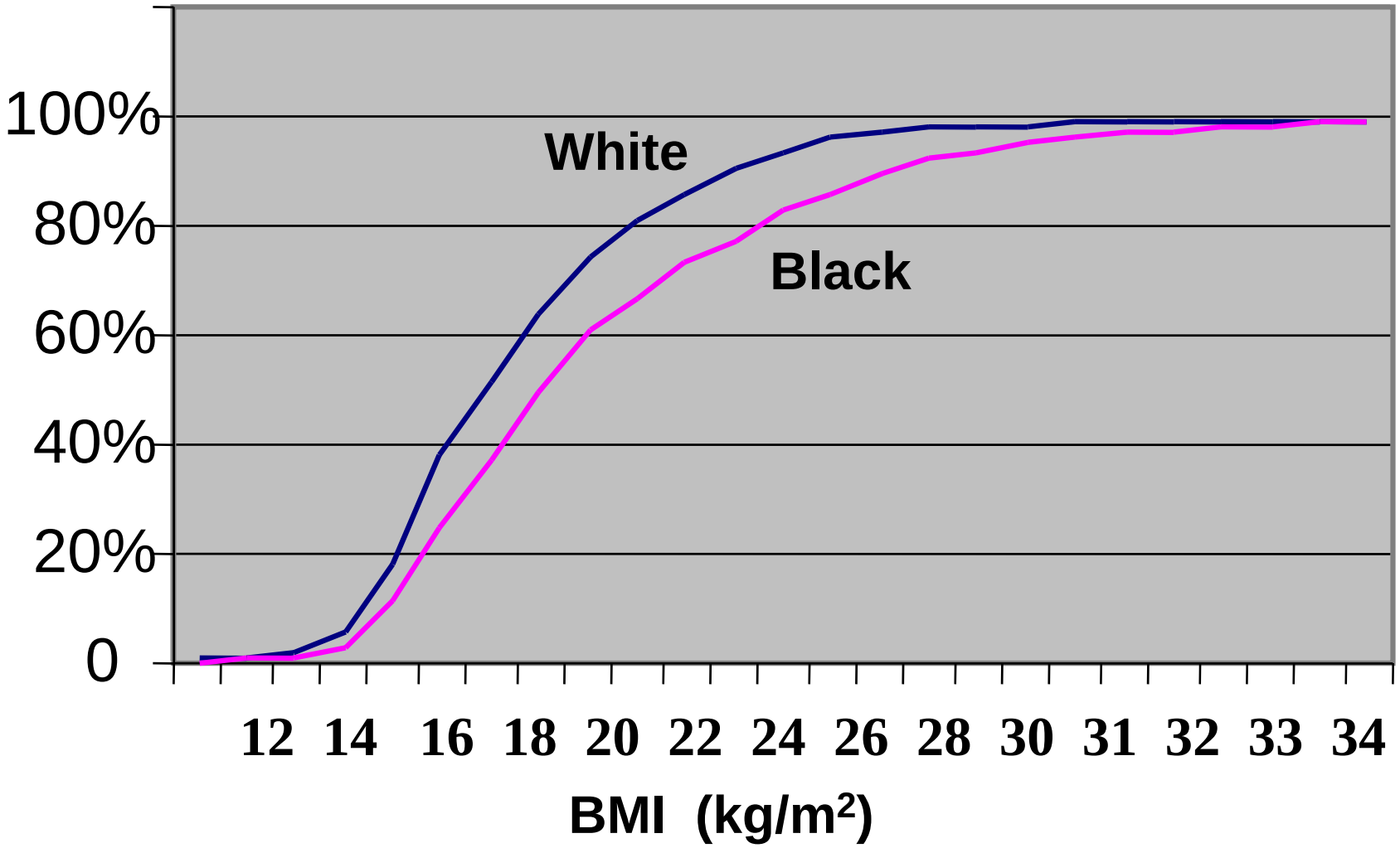
- Despite good performance of the Eqns,
- 1) BIA/anthro predicts FFM differently in B W girls
- 2) Results also suggest that total body water predicts FFM differently in non OB and OB girls;

BMI and Body Fatness in Adolescent Girls

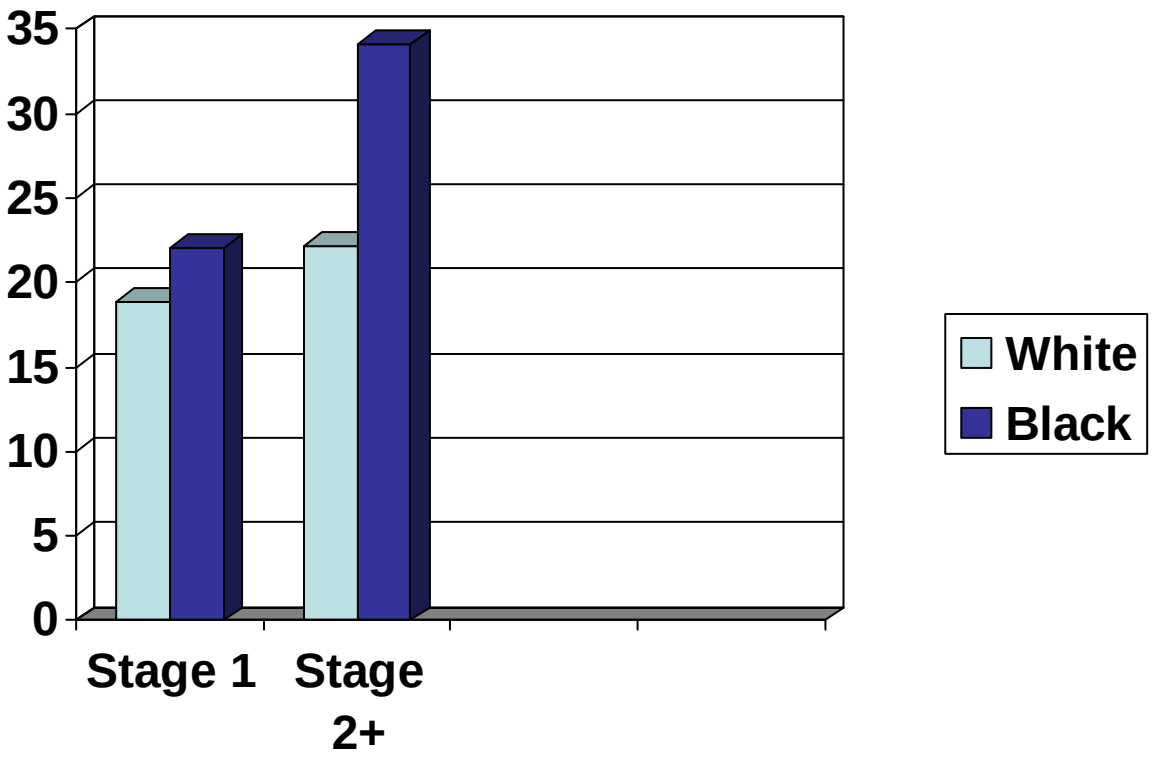
- In same NGHS ancillary sample, we assessed BMI – fatness associations.
- Fat mass determined by DXA
- Multiple regression showed BMI + race + pubertal stage were signif indep correlates of % body fat.
- For equivalent BMI, WG have more body fat

- (Peds 1997)

Cumulative distribution of BMI in White and Black Girls



95th %ile Insulin by Pubertal Stage and Race



The Glycoprotein PC-1 Gene and HOMA IR in B and W Girls

- The K121Q polymorphism of the PC-1 gene associated with Ir in an Italian population.
- We assessed this gene in 639 NGHS Ss
- Eyeballing data showed K allele assoc'd with lower HOMA, Q allele with higher
- Then numerical disaster struck.

PC-1 Genotype in 344 B and 295 W NGHS Girls

Race	KK	KQ	QQ	Total
Black Girls	15 (4%)	129 (38%)	200 (58%)	344
White Girls (Metab 2004)	222 (75%)	70 (24%)	3 (1%)	295

Concluding Remarks - 1

- BMI meets criteria as a standard
- It:
- 1.) is easy for the subjects.
- 2.) is easy for staff.
- 3.) is quick and inexpensive.
- 4.) has low technical error.
- 5.) associates with relevant factors.
- 6.) has abundant published data for compares

Concluding Remarks - 2

- Since we have seen that central adiposity provides stronger associations with some risk factors, adding waist or waist and hips increases ability to identify persons at-risk.
- Complications… may require staffing changes … does require careful training… hips lack landmark

Concluding Remarks - 3

- We have seen that BMI relates differently in WG and BG to LBM and % BF.
- Does this call for an asterisk?
- We have also seen that total body water relates to LBM differently in non-obese and obese Ss and in WG and BG.
- Does this call for an asterisk?

Concluding Remarks - 4

- The WHO Expert Panel reported varying prevalence of diabetes at the same BMI in different populations.
- MF Franklin showed that different exponents are needed with the Benn index to get a Wt-to-Ht ratio that is independent of Ht according to country, age and Ht
- How many asterisks is enough? How do asterisks and standards get along?