

Sex Differences in Obesity Rates in Poor Countries: Evidence from South Africa

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Sex differences in obesity

- Incidence of obesity is on the rise in many poor countries (Popkin and Doak 1998)
- Globally, men and women face different risks of obesity
- In all but a handful of (primarily Western European) countries, obesity is more prevalent among women than men (WHO)
- In 138 of 194 countries for which WHO reports statistics, women were at least 50 percent more likely to be obese than were men

Sex differences in obesity

- Prevalence of obesity is very high among women in Southern Africa (Martorell et al. 2000)
- In South Africa, 1998 DHS finds 60 percent of African (Black) women were overweight or obese, with obesity rates 5 times higher for African women than for African men (Puoane et al. 2002)

Consequences of obesity

- Africans are not immune to the chronic health risks associated with obesity – hypertension, coronary heart disease, stroke, diabetes

Risk factors for obesity in developing economies

- Focus has been on factors that shift the calorie intake-expenditure balance, including:
 - Urbanization (which can lead to reduced physical activity)
 - Availability of lower priced calories
 - A “Westernization” of diets
 - Importation of high-fat foods into low-income countries

Risk factors for obesity

- These may all contribute to the increase in prevalence of obesity. However, they do not explain the higher rates of obesity found among women.

- In this paper, we examine several potential explanations for the much higher rate of obesity we observe for African women
- We analyze both the proximate causes of obesity (physical exertion and food intake)
- And underlying causes of obesity (childhood and adult poverty, depression, preferences about obesity)

Preview of findings:

Three factors associated to the greater obesity rates we find among women:

- 1. Women who were nutritionally deprived as children are significantly more likely to be obese as adults. Men are not.
- 2. Women with control over household resources are more likely to be obese. Men are not.

These two factors can 'explain' 100 percent of the difference in obesity rates between men and women

- 3. Difference in preferences. More speculatively, women's perceptions of an 'ideal' female body are larger than men's perceptions of an 'ideal' male body
Women and men with control over resources may be targeting different body shapes

Proximate causes of obesity

- Obesity results from an imbalance in calorie intake and expenditure

$$P(y = 1) = x_b \gamma_b + u > 0$$

$$y = 1 \quad \text{if BMI} > 30$$

x_b are observable components of energy intake and expenditure

Proximate causes of obesity

- Surveys capture only a fraction of calories consumed

$$u = x_{b^*} \gamma_{b^*} + e$$

x_{b^*} are unobservable components of energy intake and expenditure

$$P(y = 1) = x_b \gamma_b + x_{b^*} \gamma_{b^*} + e$$

Underlying causes of obesity

- Caloric imbalance may be due to
 - childhood circumstances, x_c
 - adult SES, x_s
 - adult preferences and predisposition toward depression, x_d

$$x_b = x_c \alpha_c + x_s \alpha_s + x_d \alpha_d + v$$

$$x_{b^*} = x_c \alpha_{c^*} + x_s \alpha_{s^*} + x_d \alpha_{d^*} + \omega$$

Underlying causes of obesity

Substituting these into our obesity equation we have

$$P(y = 1) = x_c \beta_c + x_s \beta_s + x_d \beta_d + \varepsilon$$

Where coefficients reflect both the observable and latent determinants of obesity:

$$\beta_c = \alpha_c \gamma_b + \alpha_{c^*} \gamma_{b^*}$$

What are these underlying causes of obesity?

Childhood circumstance

- Early life conditions may have permanent sex-specific effects on appetite regulation, feeding behaviors, and body weight gain patterns.
- In animal studies, males and females have been shown to respond differently to early postnatal exposure to hypothalamic neuropeptides known to affect appetite regulation
- Varma et al. (2003) find significant sex differences in early life exposure to neuropeptide Y on adult weight control in rats .They speculate that this may be due to differential effects of sex steroids on neuropeptide synthesis and/or release.
- Research conducted on persons conceived during the Dutch famine of 1944-45 found that exposure to the famine during early gestation was associated with higher weight, higher BMI and greater waist circumference among women, but not in men (Ravelli et al. 1999).
- Luo et al. (2006) investigate the prevalence of adult obesity among men and women born in China during the Great Famine (1959-1962). Women who lived through the famine in provinces heavily hit face a significantly higher risk of obesity than do other women, while men's obesity patterns are not related to the famine.

Adult socioeconomic status

- In many studies, women have been found to have a greater say in how household decisions get made, the greater their share in total household income
- Women and men may give food different weight in their utility functions
- Differences in who makes decisions on who should eat, and how much food to buy, may lead to differences in male-female obesity rates at different levels of household SES, and at different income shares between women and men

Depression

- On average, South African women report suffering from a greater number of symptoms of depression than do men
- Studies in the US generally find a positive association between obesity and depression in women, and either a negative association, or no association between obesity and depression in men

Body size preferences

- Across cultures, there are significant differences in evaluation of body images
- If women's ideal female body is larger than men's ideal male body, this could lead to differences in obesity rates
- (but NB women may report liking the size that they are!)

Decomposing differences in obesity rates

We can re-write our obesity equation for women (F) and men (M) for proximate causes of obesity:

$$P^k(y = 1) = \sum_{i \in b} x_i \beta_i^k + e^k \quad \text{for } k = F, M$$

and for underlying causes:

$$P^k(y = 1) = \sum_{i \in c, s, d} x_i \beta_i^k + e^k \quad \text{for } k = F, M$$

Decomposing differences in obesity rates

For either proximate or underlying causes, we can then express the difference in obesity rates as a severity effect, a prevalence effect, and a residual

$$\text{Severity effect} = \sum_i (\beta_i^F - \beta_i^M) \bar{x}_i$$

$$\text{Prevalence effect} = \sum_i (\bar{x}_i^F - \bar{x}_i^M) \bar{\beta}_i$$

Data

- In 2004 and 2005 we collected data on 500 randomly selected households in Khayelitsha, an African township outside of Cape Town, South Africa
- Township contains both shacks with no services and houses with access to water and electricity
- Most households have a close connection to the Eastern Cape, from which family members originally migrated
- Poverty rates are high. So are rates of HIV and AIDS, TB, violence, and malnutrition

Table 1. Summary Statistics by Sex

	Men (n=426)	Women (n=549)	<i>p</i> -value of diff
Age	35.49	36.14	0.454
<i>Body mass index (BMI)</i>			
Indicator: underweight (BMI<18.5)	0.052	0.011	0.000
Indicator: normal (18.5≤BMI<25)	0.643	0.219	0.000
Indicator: overweight (25≤BMI<30)	0.204	0.268	0.021
Indicator: obese (BMI≥30)	0.101	0.503	0.000

BMI of Women and Men

From ages 18 to 60

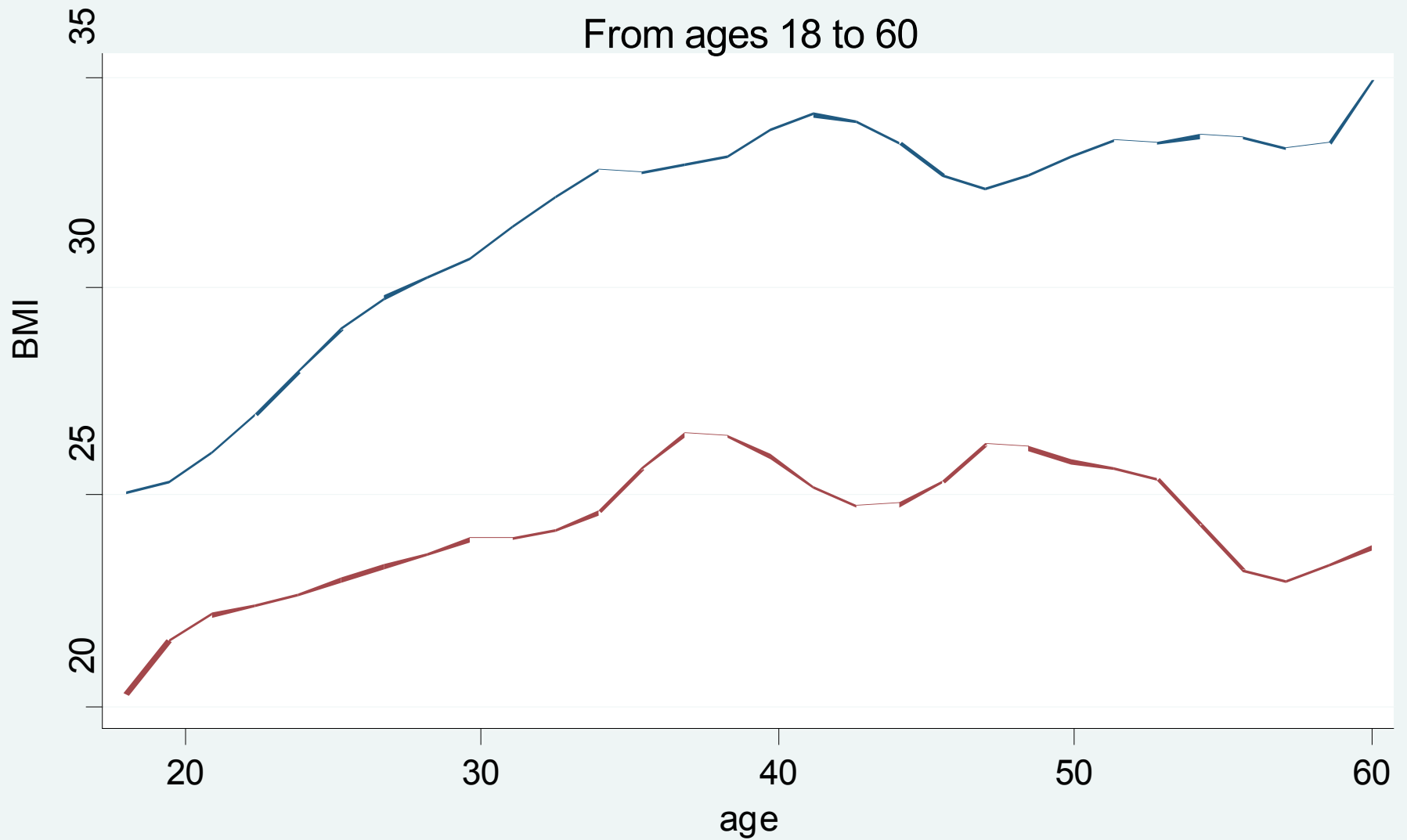


Table 1. Proximate causes of obesity

	Men (n=426)	Women (n=549)	p-value of diff
<i>Food consumption</i>			
Indicator: large breakfast	0.209	0.075	0.000
Indicator: large lunch	0.194	0.059	0.000
Indicator: large dinner	0.292	0.142	0.000
Number of large meals per day	0.698	0.272	0.000
Spoons of sugar per day	4.337	6.579	0.000
Indicator: drinks soda	0.308	0.255	0.070
<i>Physical exertion</i>			
Any exercise	0.333	0.093	0.000
Any sports	0.188	0.035	0.000
Manual Labor	0.440	0.286	0.000

Childhood SES

- “Now I’d like to ask you about what was true in the household you lived in when you were a child.”
 - Were there times when you went to bed hungry because there was no food?
 - Were there times when you went to school hungry because there was no food?
 - Did you go to other people’s houses to eat because there was not enough food?

Table 1. Underlying causes of obesity

	Men (n=426)	Women (n=549)	p-value of diff
<i>Childhood conditions</i>			
Went to school hungry	0.380	0.368	0.687
Went to bed hungry	0.378	0.338	0.198
Ate at other's homes	0.266	0.283	0.557
Child poverty index	1.021	0.982	0.630
<i>Adult socioeconomic status</i>			
Completed education	6.26	6.77	0.010
Log(exp per member)	5.490	5.361	0.003
Log(inc per member)	5.858	5.588	0.000

Table 1. Underlying causes of obesity

	Men (n=426)	Women (n=549)	<i>p</i> -value of diff
<i>Depression index</i>			
<i>CES-D (Depressed, miserable, cried a lot, poor appetite, sleep was restless, felt sad, everything an effort, could not get going)</i>			
‘Some’ or ‘Most of the time’	1.977	2.756	0.000
<i>Body shapes</i>			
Perceived current body shape	3.314	4.106	0.000
Ideal body shape	3.693	3.949	0.000

Body images

- “Sometimes we have ideas about how we look and how we might like to look.”
 - Among this set of people, which best describes your body shape?
 - Among this set of people, which best describes the body shape you would most like to have?

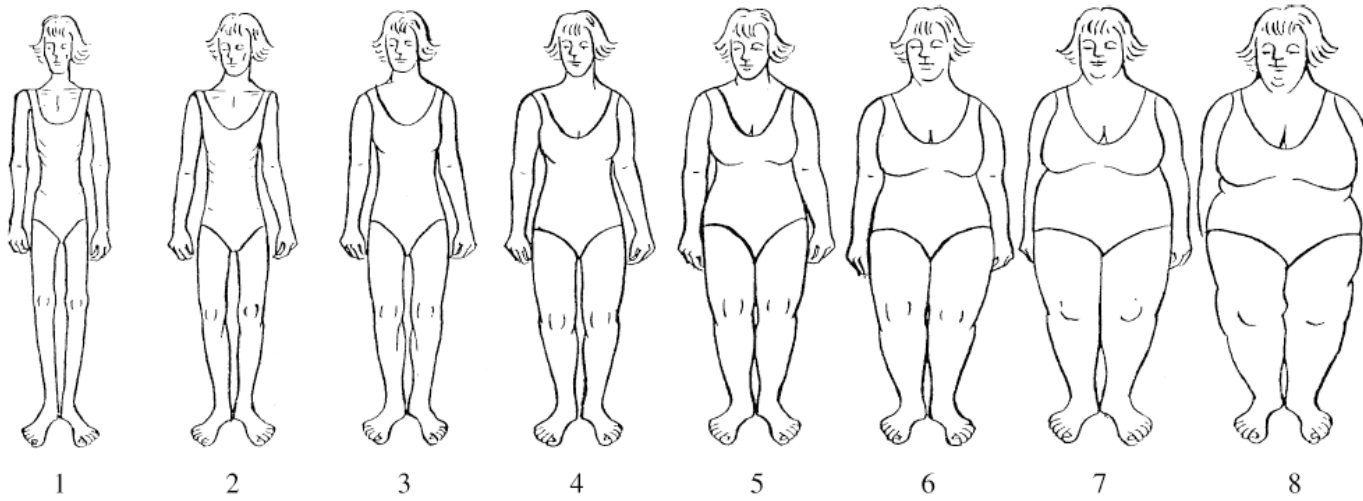


Figure 1 The illustrations of body shapes used for women.

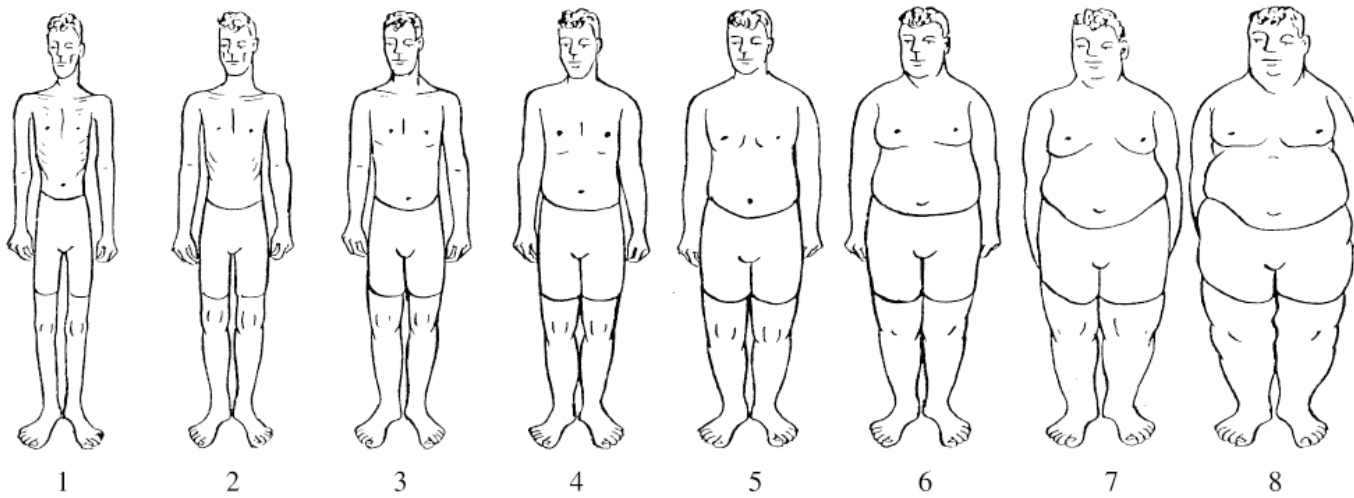


Figure 2 The illustrations of body shapes used for men.

Table 2. Proximate Determinants of Obesity
 Dependent variable =1 if BMI>30, =0 otherwise

	Women	Men
Number of large meals per day	0.039 (0.034)	-0.004 (0.018)
Indicator: Drinks soda	0.112 (0.044)	0.075 (0.037)
Sugar index	0.051 (0.022)	-0.015 (0.021)
Reports exercise	-0.007 (0.066)	0.002 (0.043)
Reports sports	-0.021 (0.110)	0.000 (0.044)
Reports manual work	-0.033 (0.048)	-0.060 (0.035)
<i>F</i> -test: calorie intake variables (<i>p</i> -value)	4.36 (0.005)	1.43 (0.235)
<i>F</i> -test: calorie expenditure variables (<i>p</i> -value)	0.18 (0.913)	1.02 (0.383)
Number of observations	536	404

Table 3. Decomposition of the Proximate Determinants

Obesity rate, women	0.503	
Obesity rate, men	0.101	
Difference (women – men)	0.402	
Severity effect	0.097	
Prevalence effect	0.002	
Fraction explained	0.246	
<hr/>		
Decomposition by variable:	Severity Effect	Prevalence Effect
Number of large meals per day	0.019	–0.007
Indicator: Drinks soda	0.010	–0.005
Sugar index	0.062	0.005
Reports exercise	–0.002	0.001
Reports sports	–0.002	0.002
Reports manual work	0.010	0.007
All	0.097	0.002

Table 4. Underlying Determinants of Obesity: Women
 Dependent variable =1 if BMI>30, =0 otherwise

	(1)	(2)
Childhood hunger index	0.048 (0.016)	0.049 (0.016)
Log (income/member)	0.041 (0.020)	--
Log (expend/member)	--	0.040 (0.033)
Education	0.019 (0.009)	0.019 (0.009)
Depression index	-0.003 (0.008)	-0.004 (0.008)
N observations	528	540

Table 4. Underlying Determinants of Obesity: Men
 Dependent variable =1 if BMI>30, =0 otherwise

	(3)	(4)
Childhood hunger index	-0.005 (0.012)	-0.006 (0.011)
Log (income/member)	-0.011 (0.014)	--
Log (expend/member)	--	-0.025 (0.019)
Education	0.009 (0.005)	0.008 (0.005)
Depression index	-0.007 (0.006)	-0.007 (0.006)
N observations	402	417

Table 5. Decomposition of the Underlying Determinants

	Using: $\log(\text{inc}/\text{member})$	
Obesity rate, women	0.503	
Obesity rate, men	0.101	
Difference (women – men)	0.402	
Severity effect	0.427	
Prevalence effect	–0.001	
Fraction explained	1.060	
Decomposition by variable:	Severity	Prevalence
	Effect	Effect
Childhood hunger index	0.053	–0.001
Log(SES measure)	0.301	–0.004
Education	0.063	0.007
Depression index	0.009	–0.004
All	0.427	–0.001

- With respect to childhood deprivation: is it nutritional deprivation, or deprivation more broadly, that is associated with obesity in women in adulthood?
- We have additional childhood measures we can use to examine this:
 - self-assessed financial status in childhood
 - reports that father held a 'regular pay job'

Table 6. Childhood SES and Adult Obesity

	Childhood hunger index		Obesity in adulthood	
	Women	Men	Women	Men
Childhood hunger index	--	--	0.063 (0.023)	-0.010 (0.017)
Childhood family finances were:				
“very comfortable” or “comfortable”	-2.207 (0.174)	-2.294 (0.171)	0.086 (0.113)	-0.050 (0.077)
“just getting by”	-1.784 (0.179)	-1.820 (0.176)	-0.011 (0.094)	0.021 (0.067)
“poor”	-0.448 (0.197)	-0.564 (0.207)	-0.009 (0.086)	-0.009 (0.059)
Father did not have a “regular pay job”	0.150 (0.119)	0.173 (0.124)	0.003 (0.047)	-0.023 (0.034)
<i>F</i> -test: joint significance of family finance indicator variables	94.41	78.99	0.67	0.89
Number of observations	474	376	474	376

- With respect to adult SES and obesity in women, are there differences in the effect of “own” income and the income of others in the household?

Table 7. Own Income, Household Income and Obesity
 Dependent variable: Obesity in adulthood

	Women		Men	
	(1)	(2)	(3)	(4)
Total household income per month (R1000)	0.033 (0.014)	0.019 (0.016)	0.005 (0.012)	-0.002 (0.013)
Own earnings from work per month (R1000)	--	0.062 (0.027)	--	0.018 (0.023)
Monthly child support grant receipt (R1000)	--	0.337 (0.169)	--	--
Childhood hunger index	0.045 (0.016)	0.042 (0.016)	-0.002 (0.012)	-0.003 (0.012)
Number of observations	511	511	375	375

- association between women's own income and obesity:
 - third factors? illness, marital status, fertility?
 - or do household members' income shares affect household decision making?

	Baseline	Health	Marriage	Fertility	Most say
Total household income per month (R1000)	0.019 (0.016)	0.018 (0.016)	0.011 (0.017)	0.021 (0.016)	0.021 (0.016)
Own earnings from work per month (R1000)	0.062 (0.027)	0.061 (0.027)	0.077 (0.028)	0.058 (0.027)	0.052 (0.027)
Monthly child support grant receipt (R1000)	0.337 (0.169)	0.328 (0.167)	0.277 (0.169)	0.299 (0.179)	0.268 (0.173)
Childhood hunger index	0.042 (0.016)	0.043 (0.016)	0.039 (0.016)	0.042 (0.016)	0.037 (0.016)
Indicator: Poor health at present	--	-0.057 (0.053)	--	--	--
Indicator: Reports feeling weak	--	0.074 (0.081)	--	--	--
Indicator: Reports body-ache	--	0.039 (0.052)	--	--	--
<i>F</i> -test: Health variables (<i>p</i> -value)	--	1.57 (0.197)	--	--	--
Indicator: married or living with partner	--	--	0.105 (0.049)	--	--
Indicator: has living children	--	--	--	0.052 (0.063)	--
Indicator: respondent has 'most say' on food spending	--	--	--	--	0.102 (0.062)

Table 9. Decisions on Household Food Spending

Dependent variable =1 if this adult is reported to have the “most say” on food spending

Female	0.172 (0.053)
Total household income (R1000)	-0.024 (0.016)
Female × total household income (R1000)	0.012 (0.020)
Own-earnings from work (R1000)	0.055 (0.032)
Female × own-earnings from work (R1000)	0.126 (0.045)
Female × child support grant receipt (R1000)	0.822 (0.157)
Number of observations	649

- Why would women choose to use their resources in this way?

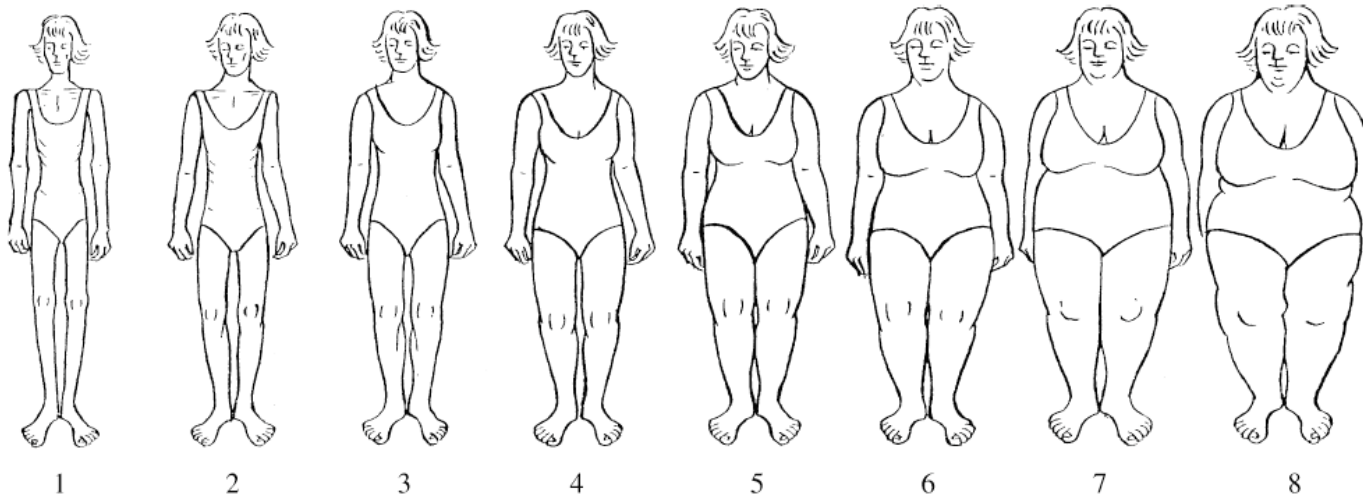


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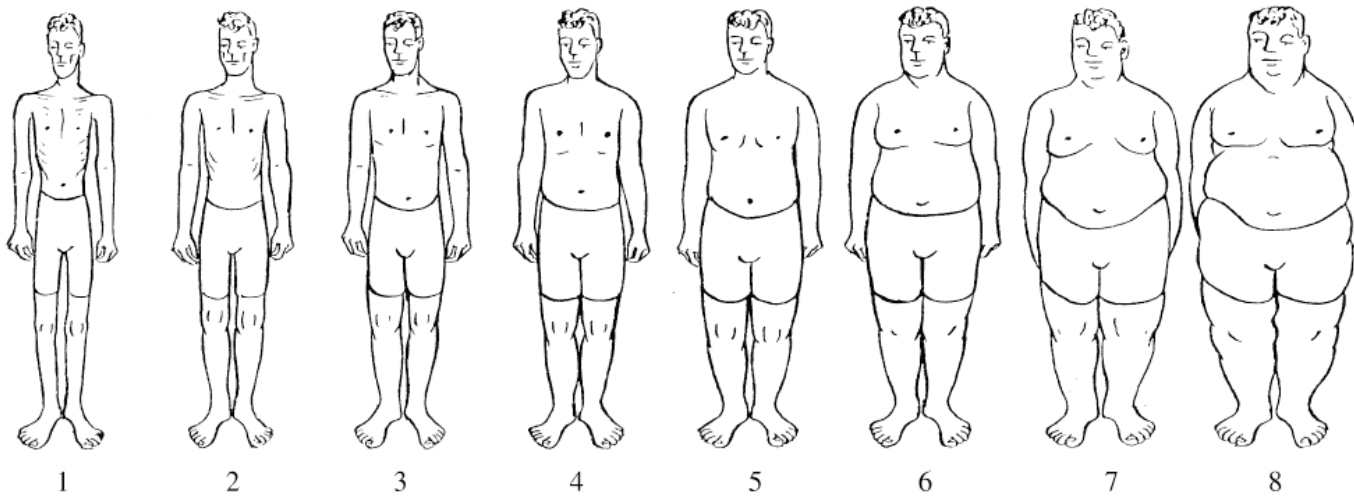
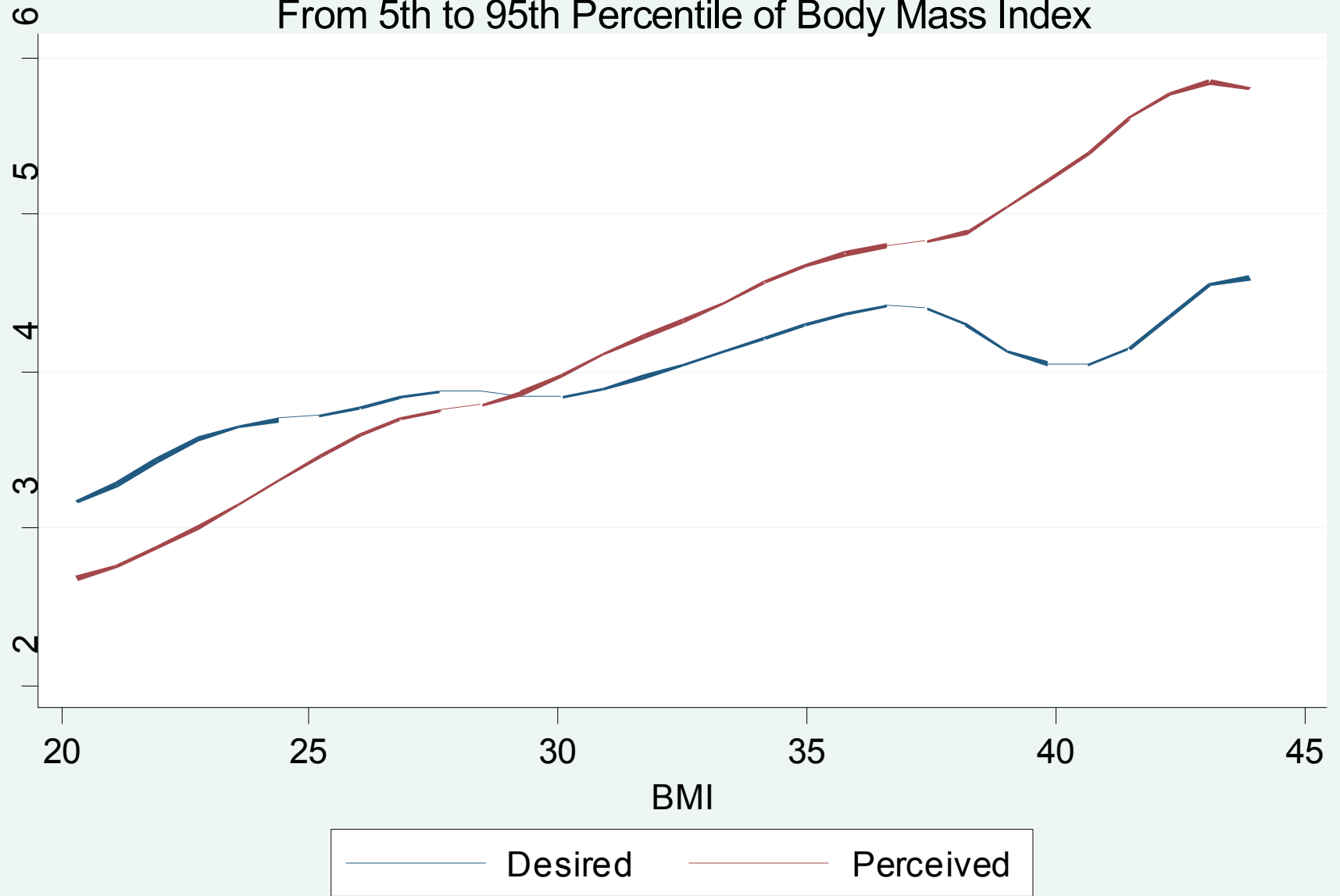


Figure 2 The illustrations of body shapes used for men.

Women's Desired and Perceived Body Images

From 5th to 95th Percentile of Body Mass Index



- On average, women's ideal size equals her self-perceived size at a BMI of 29.45
- For men, this occurs at a BMI of 24.23
- Differences in the BMI they are targeting could lead to differences between men and women in the way they spend their resources

Conclusions

- If women aspire to a high BMI, then informational campaigns that assume women want to lose weight but don't know how to do it (i.e. those stressing diet and exercise) may not be effective
- Campaigns stressing chronic disease burden may be more useful
- But even then, if women have lost the ability to regulate their appetites, due to early-life deprivation, there may be an upper bound on the success of such campaigns
- Our results on the differences in obesity risk faced by men and women, who reported similar childhood nutritional deprivation, suggest that the biology of obesity risk cannot be fully understood without understanding early-life economic disadvantage, and that the impact of socioeconomic status on obesity cannot be understood without a biological framework that can explain why women and men, facing the same nutritional deprivation as children, face quite different biological risks as adults.

Comparison of preferences between men and women. (CAPS 2006)

Ideal female body size - Blacks

	Young (17 to 27)	Older (50+)
Women Preference	3.70	4.30
Men Preference	3.50	4.20

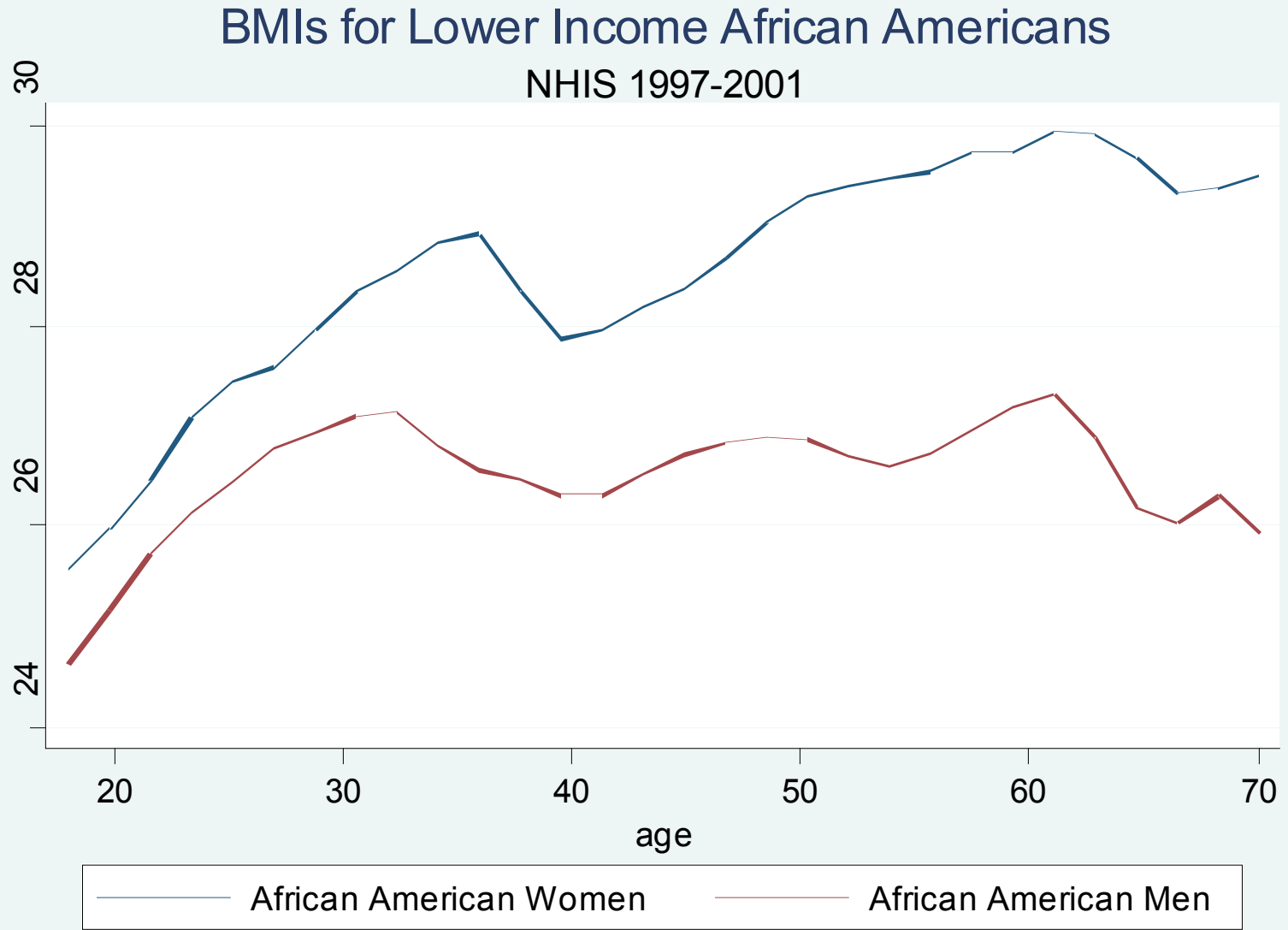
BMI for African Americans

NHIS 1997-2001



— African American Women — African American Men

BMI lower income African Americans



BMI for African American Women

