

Racial/ethnic variations in male testosterone levels: a probable contributor to group differences in health

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Racial and ethnic variations in serum testosterone levels were investigated among a large sample of male Vietnam era veterans. Based on geometric means, significant average differences were found between 3,654 non-Hispanic white and 525 black individuals. The geometric mean for testosterone levels among 200 Hispanic individuals was similar to that of non-Hispanic white individuals. Regarding two other racial/ethnic groups (Asian/Pacific Islanders and Native Americans), no significant differences were found, due perhaps to small sample sizes. Results were interpreted as having considerable potential for explaining some of the race differences in the incidences of cardiovascular diseases, hypertension, and prostate cancer. (Steroids 57:72-75, 1992)

Keywords: testosterone; race; prostate cancer; coronary heart disease, racial variations

Introduction

Long-term systemic exposure to high (i.e., male typical) levels of testosterone may have a number of adverse health effects, thereby at least partially accounting for why males of nearly all species, including humans, have shorter life expectancies than females.¹⁻⁴ Most strongly implicated in terms of the adverse health effects of testosterone are diseases of the cardiovascular system, such as heart disease and stroke.⁵⁻⁷ Prostate cancer (which, by definition, only affects males) also appears to be linked to long-term exposure to high levels of testosterone.^{8,9} Other diseases, such as those that differentially affect the sexes,¹⁰ may also be affected by testosterone and other related gonadal steroids.

Cardiovascular diseases, hypertension, and prostate cancer have been shown to be more prevalent in some racial/ethnic groups than in others, with black individuals in particular exhibiting unusually high rates of these diseases.¹¹⁻¹⁹ If differential exposure to testosterone is one of the causes of racial/ethnic differences in the rates of these diseases, it could be hypothesized that black men would have higher levels of circulating testosterone than men from other racial groups.

Two prior studies have investigated racial variations in testosterone levels. One study found guarded support for the hypothesis that serum levels are significantly higher among black men compared with white men.²⁰ Given that this study was limited to a comparison of 50 black and 50 white male college students in California, its generalizability certainly may be questioned. The other study was based on even smaller samples. It compared 11 Asian males and 12 Euro-American males with 12 Asian females and 11 Euro-American females.²¹ While major differences between the sexes were documented, this study found no significant average within-sex differences in serum testosterone levels for these two racial groups.

The present study was undertaken to more rigorously test the hypothesis that, at least among males, black men have higher levels of testosterone than white men.

Experimental

This investigation took advantage of a large data set compiled recently by the Centers for Disease Control (Atlanta, GA, USA) regarding 4,462 male army enlistees who had served at least one tour of duty during the period of the Vietnam War. All of the subjects had been discharged from the US Army sometime between 1965 and 1971.

The sample consisted of 3,654 non-Hispanics, 525 blacks, 200 Hispanics, 34 Asiatic/Pacific Islanders, and 49 Native Ameri-

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Table 1 Racial/ethnic group, age compositions, and average weight of the sample

Race/ethnicity	N	Age (yr)				Mean weight (kg)
		Mean	SD	Minimum	Maximum	
Non-Hispanic white	3,654	38.37	2.49	31.15	49.01	83.66 ^a
Black	525	38.34	2.63	31.24	46.35	83.99
Hispanic	200	38.41	2.55	31.18	44.28	81.43
Asian/Pacific Islander	34	38.14	2.30	33.73	42.99	74.59
Native American	49	37.67	3.09	32.06	44.02	85.16
All	4,462	38.35	2.52	31.15	49.01	83.55

^a In the case of one non-Hispanic white subject, weight was not reported.

cans. At the time the hormonal assays were obtained, the subjects ranged in age from 31.15 to 49.01 years, with a mean of 38.35 years. For the average age and weight distribution according to race/ethnicity, see Table 1. Between 1985 and 1986, subjects were transported to the Lovelace Medical Foundation (Albuquerque, NM, USA), where all assays were collected. Serum samples were obtained in the morning before the subjects had eaten breakfast, the time of day when testosterone levels generally have been found to be at their peak.²² Hormonal measurements were all reported in terms of nanograms per deciliter.

Results

Table 2 presents the geometric mean blood testosterone values for the five racial/ethnic groups identified in the study. Geometric means were used here instead of arithmetic means because, as is nearly always the case, all population distributions in testosterone were substantially skewed to the upper values. The statistical significance column of Table 2 indicates the degree to which each of the other four racial/ethnic groups compares with the non-Hispanic white sample. As hypothesized, compared with non-Hispanic white men, black men had significantly higher levels of serum testosterone. Hispanic and Native American men had mean values similar to white men. Male Asian/Pacific

Islanders had the highest mean value, but their mean did not differ significantly from the means for the other racial/ethnic groups.

Following the late teens, studies have shown that age is negative related to testosterone²³⁻²⁶ (with one failure to replicate).²⁷ Body weight also appears to be negatively correlated with testosterone levels.²⁸ In light of this evidence, Table 2 also shows the mean testosterone levels adjusted for age, as well as for age and weight jointly. The difference between non-Hispanic white men and black men is essentially unaltered by this statistical adjustment, and the statistical significance is increased only slightly (from $P = 0.028$ to $P = 0.016$). Age plus weight adjustments, however, considerably alter the mean level for male Asian/Pacific Islanders, suggesting that to the degree their high average testosterone level can be considered meaningful (given the sample size), it may be due to their relatively low mean weight.

Among these 31- to 50-year-old men, log testosterone levels were significantly inversely related to age ($r = -0.182$; slope of log testosterone versus age, $s = -0.0258$; $P = 0.0001$). This relationship was true for non-Hispanic white men ($r = -0.172$; $s = -0.0242$; $P = 0.0001$), black men ($r = -0.277$; $s =$

Table 2 Testosterone levels (ng/dl) according to race/ethnicity

Race/ethnicity	N	Geometric mean (log ± SD)	One-sided statistically significant ^a	Geometric mean adjusted for age	One-sided test of significance ^{a,b}	Geometric mean adjusted for age and weight	One-sided test of significance ^{a,c}
Non-Hispanic white	3,654	637 (6.457 ± 0.352)	—	637	—	637	—
Black	525	658 (6.489 ± 0.370)	0.028	657	0.029	659	0.016
Hispanic	200	633 (6.451 ± 0.393)	0.418	635	0.428	623	0.192
Asian/Pacific Islander	34	689 (6.535 ± 0.334)	0.100	688	0.114	647	0.449
Native American	49	631 (6.448 ± 0.392)	0.431	627	0.305	645	0.396

^a As compared with the mean for non-Hispanic white men.

^b Adjusted for age.

^c Adjusted for age and weight.

Table 3 Testosterone levels (ng/dl) in non-Hispanic white and black men by age

Age	T _A		T _B		T _B - T _A T _A
	N	Geometric mean (ng/dl)	N	Geometric mean (ng/dl)	
31-34.999	328	728	55	776	+6.6%
35-39.999	2,453	642	336	666	+3.7%
40-50	874	593	134	596	+0.5%

Abbreviations:

T_A, average testosterone level in non-Hispanic white men; T_B, average testosterone level in black men.

-0.0390; $P = 0.0001$), and Hispanic men ($r = -0.162$; $s = -0.0250$; $P = 0.022$). However, the relationship was weaker (smaller s) and failed to be statistically significant in the case of male Asian/Pacific Islanders ($r = -0.030$; $s = -0.0042$) or for Native Americans ($r = -0.083$; $s = -0.0106$). An overall two-sided test of differences between these slopes was not statistically significant. However, the slopes of black and non-Hispanic white men were significantly different based on a one-sided test ($P = 0.009$). There appears to be much more of a decrease in testosterone values with age in black men than in white men. Table 3 shows the results for three age groups: 31 to 34 years, 35 to 39 years, and 40 to 50 years. In the youngest age group, black men have a geometric mean testosterone level that is 6.7% greater than white men; this level declines to 3.7% by age 35 to 39 years and to 0.5% by age 40 to 50 years.

The average difference between non-Hispanic white men and black men observed in this study was considerably less than that reported by Ross et al. for males in their late teens and early twenties.²⁰ Specifically, whereas in our study black men had only 3.3% higher serum testosterone levels than non-Hispanic white men, in the Ross et al. study, black men had 19% higher levels than "white" men (presumably including only non-Hispanics). This difference appears to be almost entirely explicable in terms of age in light of our finding that most of the differences between non-Hispanic white men and black men were concentrated in the younger-aged subjects (i.e., those between 31 and 34 years of age).

Discussion

Overall, small but significant average racial differences in serum testosterone were found when comparing middle-aged black men and non-Hispanic white men. Even though racial differences appear to be small and largely confined to younger subjects, over decades of increased exposure, black men could acquire an increased probability of contracting various diseases, such as cardiovascular diseases, hypertension, and prostate cancer, compared with non-Hispanic white men.

Nearly all prior attempts to explain racial differences in diseases have focused on sociocultural factors.^{29,30} While this study certainly does not exclude the involvement of sociocultural factors, it would be more compatible with the view that biochemical factors, possibly mediated by genetic influences, are playing a significant role.

With regard to racially linked genetic factors, recent evidence has shown that black men exhibit biochemical responses to stress that are, on average, distinct from white men, i.e., black men produce higher beta-endorphin levels in response to stress.³¹ Interestingly, a recent study in rats found that gonadal steroids fundamentally alter beta-endorphin levels.³² If causal connections between sex hormones and beta-endorphin responses to stress also are present in humans, it could help to account for how a complex set of biochemical variables occurring within stressful environmental circumstances might produce racial variations in various disease processes.³³ Following these leads in conjunction with the evidence from the present study may one day make it possible to reduce some of the alarming disparities between racial/ethnic groups in the incidence of various life-threatening diseases.

Finally, we would like to allude to the concern that may be raised about the propriety of probing into this sensitive area of research. We are aware that average racial/ethnic differences in testosterone levels may not only help to explain group variations in disease, but could also be relevant to group differences in behavior patterns, given that testosterone and its metabolites are neurologically very active.^{34,35} While cognizant of the possible misuse of information on race differences in sex steroids, we consider the prospects of beneficial effects to be much greater, particularly in the field of health. Nevertheless, especially in the short-run, scientists should be on guard against even the hint of any misuse of research findings in this area.

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