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TESTOSTERONE, CRIME, AND MISBEHAVIOR AMONG 692 MALE PRISON INMATES

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Summary—Testosterone, crime, and prison behavior were examined among 692 adult male prison inmates. Testosterone was measured from saliva samples, and behavior was coded from prison system records. Inmates who had committed personal crimes of sex and violence had higher testosterone levels than inmates who had committed property crimes of burglary, theft, and drugs. Inmates with higher testosterone levels also violated more rules in prison, especially rules involving overt confrontation. The findings indicate differences between low and high testosterone individuals in the amount and pattern of their misbehavior.

INTRODUCTION

The link between testosterone and criminal behavior has been studied for more than 20 years, with mixed results. Testosterone has been related to toughness, status, dominance, and violence in the criminal history and prison behavior of inmates (Dabbs, Frady, Carr & Besch, 1987; Dabbs, Jurkovic & Frady, 1991; Ehrenkranz, Bliss & Sheard, 1974; Kreuz & Rose, 1972), although not all researchers have found these relationships (Bain, Langevin, Dickey, Hucker & Wright, 1988; Bain, Langevin, Dickey & Ben-Aron, 1987). There have been no reports of overall differences in testosterone between criminal and non-criminal populations.

Uncertainty about the role of testosterone has arisen in part from the use of small samples, ranging from fewer than 30 to about 100 prison inmates. Small samples lack the statistical power to detect relationships that may be weak. Small samples also make it difficult to study differences in testosterone levels across different kinds of crime, because the subjects committing a particular crime, such as murder, will be few indeed. If testosterone is to be useful in criminology, we need more confidence regarding its overall relationship to crime, along with more knowledge about the crimes to which it is mostly related.

The present study employed a relatively large sample, containing 692 *S*s. The sample comprises two sets, one with 202 *S*s about whom some findings have been reported before (Dabbs *et al.*, 1987, 1991), and one with 490 new *S*s. In examining overall relationships of testosterone to criminal violence and prison behavior, the second set was used to cross-validate findings from the first set. In examining detailed relationships between testosterone and different crimes and behaviors in prison, the two sets were combined into a single sample.

METHOD

Subjects

*S*s were adult male inmates in a maximum security state prison. Their mean age was 19.8 yr (SD = 2.6). Two-thirds were black and one-third white. Thirty-four per cent had prior juvenile or adult convictions, 37% had prior incarcerations since age 17 yr, and only 5% had been fully employed during the 6 months prior to committing the crime for which they were currently incarcerated. Their mean Wide Range Aptitude Test reading score was at seventh grade level. Their median sentence length was 6.1 yr (range 0.5–89.0). In prison they lived in prison dormitories (15%), cells (21%), and a diagnostic unit where all incoming inmates spend 1–2 months (64%). A comparison of *S*s in the two sets is presented in the results section.

Testosterone scores

Testosterone was measured from saliva samples. Each *S* voluntarily consented to participate and collected 3 ml saliva in a 20-ml vial for testosterone assay. Salivary and serum testosterone levels are highly correlated (Navarro, Jaun & Bonnin, 1986). Day-to-day reliability of salivary testosterone measurements is about $r = 0.64$ (Dabbs, 1990), about the same as the reliability of serum testosterone measurements (Gutai, Dai, LaPorte & Kuller, 1988). The reliability of measurements among 15 *S*s who appeared in our present prison sample on two occasions a mean of 15 months apart was $r = 0.76$, $df = 14$, $P < 0.01$. Saliva was collected unstimulated for the first 202 *S*s and stimulated by sugar-free chewing gum for the last 490; using gum makes it easier to collect saliva and does not affect assay scores (Dabbs, 1991). *S*s had been in prison a median of 47 days (range 0–2546) when samples were collected. Samples were collected between 8:30 and 10:00 a.m. and stored frozen until assayed.

Saliva samples from the first 202 *S*s were collected in 1985 and 1987 and assayed in one clinical laboratory (Dabbs *et al.*, 1987, 1991). Samples from the remaining *S*s were collected during the years 1990–1992 and assayed in a second laboratory. Each laboratory assayed samples in duplicate, using in-house ^{125}I-Testosterone radioimmunoassays with ether extraction and charcoal separation. The mean within-assay coefficient of variation was less than 10%.

Combining data from different assays requires considerable care, because changes in reagents, personnel, and other factors in routine laboratory operation can affect results. Samples from the first 202 *S*s were assayed in two groups, of 89 and 113 samples each. Samples from the remaining 490 *S*s were assayed in batches of 15–50 samples each. Scores from different assays were adjusted as follows and then combined into a single data set. Samples from a control pool that remained constant across the study period were included in each assay among the 490 *S*s, and inter-assay variation was statistically controlled by multiplying each testosterone score by the ratio of the mean control value for all assays, divided by the control value for its own assay. Among the first 202 *S*s, comprising the two groups of 89 and 113 each, control values were not available, and constants were added to the scores to make the mean of each group equal to the mean of the last 490 *S*s.

Prison records

Information on *S*s' behavior was obtained from prison system computer records, which are updated continuously. This information was extracted at the end of the study and merged with *S*s' testosterone scores.

Each *S* had a crime of record, it being either the crime, or the most serious of several crimes, for which he was currently serving time. The crime of record was designated by the Department of Corrections as violent or nonviolent, following a Federal Bureau of Investigation (1984) distinction between personal crimes and property crimes. The most frequent violent crimes were robbery (25%) and assault (11%), and the most frequent nonviolent crimes were burglary (21%) and drug offenses (10%). No information was available on what crimes *S*s committed prior to the crime for which they were currently incarcerated.

While in prison, *S*s receive disciplinary reports (DR's) for violations of prison rules. Our *S*s received a total of 7416 DR's for 85 different violations, ranging from fighting to wearing unauthorized clothing. The frequency of DR's per *S* was skewed, with a mean of 11 and a range from 0 to 151. We assigned an overall 0–1 score to indicate whether each *S* had any DR's at all. We also assigned 85 separate 0–1 scores to indicate whether the *S* had DR's for each of the 85 different kinds of violation.

RESULTS

Cross-validation: testosterone, crime, and prison behavior in two samples

Table 1 describes the two sets of *S*s. *S*s in Set 2 were older, more often black, and more often incarcerated for violent crimes, but the differences were not statistically significant ($P > 0.10$). *S*s in Set 2 did have significantly higher WRAT reading levels, $t(690) = 5.80$, $P < 0.001$, and longer sentences, $t(690) = 2.81$, $P < 0.01$, than *S*s in Set, 1, and more of them had received DR's, χ^2 ($df = 1$, $N = 692$), $P < 0.05$.

The standard deviation among testosterone scores was 2.6 ng/dl in Set 1 and 3.4 ng/dl in Set 2. Mean testosterone scores were 8.3 ng/dl for the first 87 *S*s in Set 1 (Dabbs *et al.*, 1987), 6.6 ng/dl for the

Table 1. Characteristics of *Ss* in Set 1 and Set 2

	Set 1	Set 2
Mean age	19.7 yr	19.9 yr
Mean WRAT reading level	6.0	7.6
Mean sentence length	10.6 yr	8.6 yr
Percentage of inmates white	34	28
Percentage of inmates black	66	72
Percentage of crimes violent	52	57
Percentage of inmates with DR's	82	73

second 113 *Ss* in Set 1 (Dabbs *et al.*, 1991), and 9.0 ng/dl for the 490 *Ss* in Set 2. These means are within the normal range and similar to means reported for men in various occupations (Dabbs, de La Rue & Williams, 1990). Differences among the means were due in part to having the assays conducted in different laboratories. We added constants to make the means in Set 1 equal to the mean of Set 2, as described above. This adjustment to a common mean level did not introduce bias into the relationships reported below, and it eliminated a between-groups source of error.

Testosterone in both sets was related to crime of record and behavior in prison. Testosterone was correlated with violence of crime marginally in Set 1 (bi-serial $r = 0.12$, $df = 201$, $P < 0.10$) and significantly in Set 2 (bi-serial $r = 0.19$, $df = 489$, $P < 0.01$). The marginal relationship in Set 1 reflected a combination of a significant relationship in the first 87 cases (Dabbs *et al.*, 1987) and a nonsignificant relationship in the next 113 cases (Dabbs *et al.*, 1991). Testosterone was correlated with having at least one DR in Set 1 (bi-serial $r = 0.20$, $df = 201$, $P < 0.001$) and in Set 2 (bi-serial $r = 0.23$, $df = 489$, $P < 0.001$). For the combined sets, more higher testosterone *Ss* committed violent crimes (bi-serial $r = 0.18$, $df = 691$, $P < 0.001$) and received at least one DR in prison (bi-serial $r = 0.22$, $df = 691$, $P < 0.001$). Mean testosterone levels for *Ss* who committed violent or nonviolent crimes were 9.5 (SD = 3.3) and 8.4 (SD = 3.0) ng/dl, respectively. Mean testosterone levels for *Ss* who had no DR's or one or more DR's were 7.7 (SD = 2.4) and 9.4 (SD = 3.3) ng/dl, respectively.

Combined sample

Crimes. In addition to treating testosterone as a continuous variable in the combined sample of 692 *Ss*, we classified each *S* as being in the lower, middle, or upper third of the testosterone distribution. This loses some information available in the continuous distribution, but it has the advantage of focusing on extreme groups. We then followed an epidemiological approach, treating high testosterone as a factor increasing the risk (or likelihood) of criminal violence and misbehavior in prison. We computed Cochran–Mantel–Haenszel statistics (SAS Institute, 1985) to contrast the risk of a behavior occurring among *Ss* in the upper third of testosterone with the risk of the same behavior occurring in the lower third. A risk ratio of 2.0, for example, would characterize a behavior twice as likely in the upper third as in the lower third. A risk ratio is statistically significant when its confidence interval excludes 1.0. Table 2 shows the risk of having committed violent crime was 1.4 times greater for a *S* in the upper third than the lower third of the testosterone distribution. The risk of receiving a DR was 1.3 times greater in the upper third than the lower third.

In the combined sample, we also examined the relationship of testosterone to different crimes. We examined nine specific types of crime, all committed by more than 25 inmates, and a combined type

Table 2. Percentage of low, medium, and high testosterone inmates committing violent crimes and violating prison rules

	Testosterone group[a]			
Activity	Lower third	Mid third	Upper third	Upper/lower risk ratio[b]
Committed violent crimes ($n = 395$)	46	54	66	1.4*
Violated prison rules ($n = 524$)	67	71	88	1.3*

[a]Cell entries are rounded to the nearest per cent.

[b]Risk ratios represent the likelihood of an activity among *Ss* in the upper third of the testosterone distribution, relative to its likelihood among *Ss* in the lower third. If the likelihoods in the upper and lower thirds are equal, the risk ratio will be 1.0.

*Confidence intervals of the risk ratio do not overlap 1.0 ($P < 0.05$).

Table 3. Percentage of low, medium, and high testosterone inmates committing different types of crime

Type of crime	Testosterone group[a]			Upper/lower risk ratio[b]
	Lower third	Mid third	Upper third	
Rape ($n = 35$)[c]	2	5	8	3.6*
Child molestation ($n = 25$)[d]	2	3	6	2.6
Homicide ($n = 45$)[e]	4	6	9	2.1*
Robbery ($n = 72$)	8	12	12	1.5
Armed robbery ($n = 100$)	13	15	16	1.2
Assault ($n = 77$)	11	9	13	1.2
Misc. other ($n = 56$)[f]	8	10	6	0.8
Burglary ($n = 147$)	25	21	18	0.7
Theft ($n = 65$)	11	12	6	0.5*
Drugs ($n = 70$)	16	7	7	0.4*

[a]Cell entries are rounded to the nearest per cent.
[b]Risk ratios represent the likelihood of an activity among *Ss* in the upper third of the testosterone distribution, relative to its likelihood among *Ss* in the lower third. If the likelihoods in the upper and lower thirds are equal, the risk ratio will be 1.0.
[c]Does not include statutory rape.
[d]Includes 16 cases of child molestation and nine cases of aggravated child molestation. Mean testosterone levels for molestation and aggravated molestation were 9.8 and 11.4 ng/dl, respectively, $t < 1.0$.
[e]Includes murder and voluntary homicide; does not include involuntary homicide.
[f]Includes 31 violent and 25 nonviolent crimes.
*Confidence intervals of the risk ratio do not overlap 1.0 ($P < 0.05$).

made up of the remaining less frequent crimes. We used χ^2 as an overall test to determine whether different crimes were committed by *Ss* in the lower, middle, and upper thirds of testosterone. We computed risk ratios to reflect the difference in likelihood of committing specific crimes in the upper and lower thirds of the testosterone distribution. Table 3 summarizes this information.

The crimes in Table 3 are ordered by their risk ratios from those committed most by high testosterone *Ss* to those committed most by low testosterone *Ss*. Testosterone level was significantly related to type of crime, χ^2 ($df = 18, N = 692$) = 43.73, $P < 0.001$ (although the χ^2-test does not speak to the particular ordering of crimes in Table 3). Risk ratios indicated four of the 10 crimes were significantly associated with testosterone. High testosterone was associated with crimes of sex and violence, and low testosterone was associated with burglary, theft, and drug offenses. Figure 1 displays this information differently, showing the percentage of each kind of crime committed by high, medium, and low testosterone *Ss*.

Disciplinary reports. We used analysis of variance to determine whether the pattern of DR's received was different for *Ss* in the lower, middle, and upper thirds of testosterone. χ^2 was not appropriate for this analysis, because a *S* could have several different kinds of DR's and the responses were thus not independent. We computed risk ratios of the difference in likelihood of receiving specific DR's in the upper and lower thirds of the testosterone distribution.

The DR's in Table 4 are ordered by their risk ratios from those received most by high testosterone *Ss* to those received most by low testosterone *Ss*. In the analysis of variance, the 0–1 DR scores were treated as dichotomous measures of continuous variables. The three testosterone levels constituted three levels of a between-subjects factor, and the 10 DR categories constituted 10 levels of a within-subjects factor. A significant group effect indicated more DR's among higher testosterone *Ss*, $F(2,689) = 6.55$, $P < 0.01$. A significant DR effect indicated some DR's more likely than others, $F(2,6201) = 169.62$, $P < 0.001$. And a significant group by DR interaction indicated that *Ss* with different testosterone levels had different DR's, $F(18,6201) = 3.97$, $P < 0.001$. Risk ratios indicated five of the 10 DR categories significantly associated with testosterone. High testosterone was associated especially with violations involving overt confrontation. As with the crimes, Fig. 1 displays this information differently, showing the percent of each kind of DR received by high, medium, and low testosterone *Ss*.

Testosterone across time. Contrary to findings from a shock incarceration prison (Thompson, Dabbs & Frady, 1990), entering prison did not appear to lower testosterone levels. Because we had only one testosterone measure from each *S*, it was not possible to track changes over time within individual *Ss*. However, mean testosterone levels were not different between *Ss* who had been in prison

Table 4. Percentage of low, medium, and high testosterone inmates with at least one disciplinary report for violation of prison rules

Type of violation	Testosterone group[a]			Upper/lower risk ratio[b]
	Lower third	Mid third	Upper third	
Unauthorized presence ($n = 113$)	11	19	19	1.7*
Assault with injury to inmate ($n = 189$)	21	29	32	1.6*
Assault on inmate ($n = 200$)	23	29	35	1.5*
Failure to follow instructions ($n = 452$)	56	59	81	1.5*
Participation in disturbance ($n = 131$)	15	21	21	1.4
Verbal threat ($n = 108$)	14	13	20	1.4
Insubordination ($n = 328$)	43	45	54	1.3*
Lying ($n = 134$)	17	20	21	1.2
Property damage ($n = 87$)	13	12	13	0.9
Unauthorized absence ($n = 89$)	15	12	12	0.8

The ten most common violations are included in the table.
[a]Cell entries are rounded to the nearest per cent.
[b]Risk ratios represent the likelihood of an activity among *Ss* in the upper third of the testosterone distribution, relative to its likelihood among *Ss* in the lower third. If the likelihoods in the upper and lower thirds are equal, the risk ratio will be 1.0.
*Confidence intervals of the risk ratio do not overlap 1.0 ($P < 0.05$).

for 1–30 days and those who had been in 31–60 days, $t(369) = 0.11$, n.s. These *Ss* came primarily from the diagnostic intake unit. We examined only the first 60 days because in this period no *Ss* would have completed their time and been released, ensuring that we had a representative sample of *Ss* convicted of all types of crime.

DISCUSSION

The present study supports earlier findings relating testosterone to criminal violence, and it provides details not available from earlier studies. Similar testosterone effects were found in two different sub-sets of data, even though there were significant differences between *Ss* in the two sets. Pooling the sub-sets to produce a large overall sample allowed us to draw conclusions about different kinds of crime. We found testosterone related to crimes of sex and violence. We clarified Rada, Laws, Kellner, Stivastava and Peake's (1983) mixed evidence linking testosterone to rape and child molestation. And we related testosterone to prison behavior as well as to type of prior criminal behavior outside of prison.

The findings provide information about criminal behavior among low as well as high testosterone individuals. While certain crimes and misbehaviors are characteristic of high testosterone, others are characteristic of low testosterone. The rule violations shown at the top and bottom of Fig. 1 may be emblematic of high and low testosterone individuals. High testosterone individuals are dominant and confrontational, and they showed up where they did not belong (often to engage in illicit activity, according to prison staff). Those low in testosterone hold back, and they are notable more by their absence than their presence.

The relationship of testosterone to specific rule violations should not obscure the fact that higher testosterone inmates overall had more rule violations. The variety of rule violations suggests the behavior of high testosterone individuals reflects intractability, unmanageability, and lack of docility as well as aggression and violence. This fits with findings about occupations (Dabbs, 1992) and college fraternities (Dabbs, Hargrove & Heusel, 1993), as well as with Albert, Walsh and Jonik's (1993) conclusion that testosterone is related to something other than simple aggression.

A question may arise as to whether *Ss* who committed drug offenses were low in testosterone because activity with drugs lowered testosterone, or because lower testosterone led to their drug crimes. Prison system records contained information on prior drug use for 476 of the 692 *Ss* and among these *Ss* drug use was reported more for those who committed drug crimes, χ^2 ($df = 1$, $N = 476$) $= 32.53$, $P < 0.001$. Both marijuana and heroin have a temporary effect of lowering testosterone levels (Kolodny, Lessin, Toro, Masters & Cohen, 1976; Mendelson & Mello, 1975). But even if *Ss*' testosterone levels had been lower when they committed drug crimes, because they were using drugs at that time, it seems likely their levels would have recovered by the time we collected

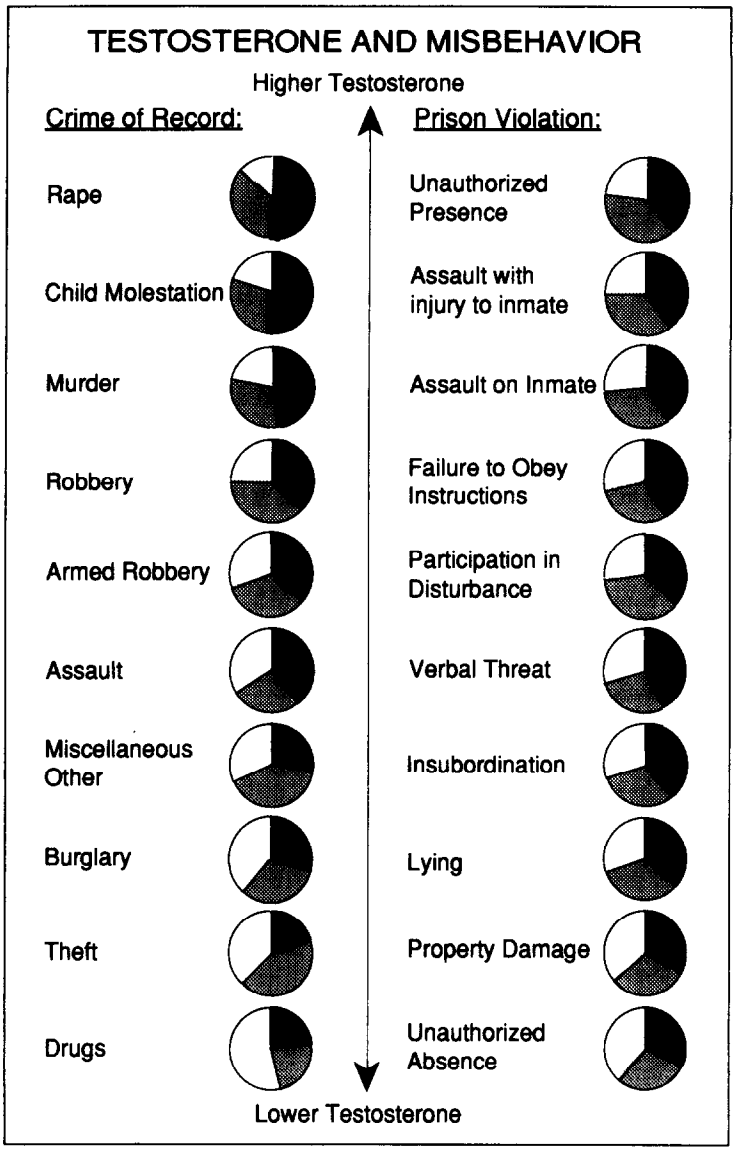

Fig. 1. Percentage of different crimes and prison violations attributable to *Ss* in lower (white), middle (gray), and upper (black) thirds of the testosterone distribution. Crimes and prison violations are ordered such that high testosterone *Ss* more often do those near the top of the figure, and low testosterone *Ss* more often do those near the bottom.

their saliva samples in prison. We doubt that those who committed drug offenses were using more drugs in prison than other *Ss* were. Correctional officers told us the primary drug found in prison was marijuana, and they did not associate its use more with one kind of inmate than with another.

The true relationships between testosterone and behavior are probably higher than indicated in the present study. The day-to-day reliability of testosterone measurements from *Ss* assayed in the same laboratory is about $r = 0.64$ (Dabbs, 1990). The Spearman–Brown formula indicates this much unrealibility in measurements will reduce an observed testosterone–behavior relationship to about 0.8 of its true value. For example, an observed relationship of $r = 0.20$ would reflect an underlying true relationship of about $r = 0.25$. The observed testosterone–behavior relationships will be further attenuated by the unreliability of assays performed in different laboratories (Dabbs, Campbell, Gladue, Midgley, Navarro, Read, Susman, Swinkels & Worthman, 1994) and unreliability in the measurement of *Ss*' characteristic behavior.

The present study documents relationships between testosterone and behavior in a sizeable

sample of prison inmates. We need now to examine the causal role of testosterone, and to explore the pathways through which testosterone might operate and conditions that might modify its effects. These mediating and moderating variables (Baron & Kenny, 1986) can lead to different effects in different settings and populations. For example, social control forces in education and family background can attenuate the negative effects of testosterone (Dabbs & Morris, 1990; Udry, 1990). And although there are significant mean differences in testosterone between inmates who commit different kinds of crimes, inmates who commit a given crime vary greatly among themselves in testosterone. We plan now to examine within-crime variation, looking for example at differences in the activities of high and low testosterone murderers, or of high and low testosterone burglars. Research involving such detailed questions is aided by having large samples of *S*s and using salivary measures makes it easier to get *S*s.

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