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Men in committed, romantic relationships have lower testosterone

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Abstract

Variation in human male testosterone levels may reflect, and effect, differential behavioral allocation to mating and parenting effort. This proposition leads to the hypothesis that, among North American men, those involved in committed, romantic relationships will have lower testosterone levels than men not involved in such relationships. Our study is the first to examine whether being in such a relationship (rather than being married) is the meaningful predictor of male testosterone levels. To test this hypothesis, 122 male Harvard Business School students filled out a questionnaire and collected one saliva sample (from which testosterone level was measured). Results revealed that men in committed, romantic relationships had 21% lower testosterone levels than men not involved in such relationships. Furthermore, the testosterone levels of married men and unmarried men who were involved in committed, romantic relationships did not differ, suggesting that, at least for this sample, male pair bonding status is the more significant predictor of testosterone levels than is marital status.

Keywords: Testosterone; Pair bond; Marriage; Male reproductive effort

Introduction

Variation in human male testosterone (T) levels may reflect and effect differential behavioral allocation to mating and parenting effort. Both major components of mating effort—male–male competition and mate seeking—seem to be facilitated by T. Mazur and Booth (1998) argue that T facilitates success in dominance interactions. When dominance is mediated by aggression, T also appears to facilitate this process. A recent meta-analysis, summarizing the results of 45 human studies, found a consistent, positive relationship between aggression and T (Book et al., 2001). T also facilitates libido (e.g., Wang et al., 2000), although debate remains whether a T threshold is sufficient to maintain libido or whether dose–response relationships exist (Buena et al., 1993; Davidson et al., 1979; Mazur et al., 2002). By increasing libido, higher T may encourage mate-seeking behavior.

By contrast, both long-term bonds with a mate and paternal care seem indicative of reduced mate seeking effort and increased parenting effort, at least in North America. Two studies of U.S. military veterans revealed lower T levels among married men (Mazur and Michalek, 1998; Booth and Dabbs, 1993). Among a sample of 58 Boston-area subjects, married men had lower evening T levels than unmarried men, and this difference was greater among the married fathers (Gray et al., 2002). Three different samples of Canadian men revealed lower T levels associated with paternal care (Berg and Wynne-Edwards, 2001; Fleming et al., 2002; Storey et al., 2000).

To date, relatively little research has tested the idea that certain male relationships, such as long-term affiliative bonds with a mate as well as fathering, are linked with lower T levels. More data are needed to determine how robust a phenomenon this is in North America. Here, we present new data to test the hypothesis that certain kinds of relationships are associated with lower T levels in males. For the first time, we test the hypothesis that being in a committed, romantic relationship, *whether married or not*, is associated

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with lower T levels. Previous studies have examined marital and parental status as predictor variables—not pair bonding status itself.

Materials and methods

All participants ($N = 122$) in this study were a single cohort of graduate business students, aged 23–24 years, at the Harvard Business School. Thirty-four of the subjects were married without children (average age 28.2 years), 9 were married with children (average age 28.8 years), 38 were "paired" (in a "serious, committed, romantic relationship" but not married, average age 27.3 years), and 41 were "unpaired" (not in a relationship, average age 27.3 years).

Each participant collected one saliva sample from which his testosterone level was measured. Subjects were given a stick of Carefree sugarless chewing gum to stimulate saliva production. All samples were collected between 10:00 and 10:20 A.M. over a 9-day period in spring 2002. This time corresponded with a break between business school classes. All students are on the same schedule of classes and remain in the same classroom and seating configuration from 8:40 A.M. until noon, further controlling the conditions of collection. At the time of saliva collection, each participant also filled out a short questionnaire containing information on relationship background and other demographic data. Participants received a nominal amount (US$10) for completing these items. This study was approved by the Committee on the Use of Human Subjects at Harvard University.

Saliva samples were assayed for testosterone in the Reproductive Ecology Laboratory, Harvard University, using a modified application of the ^{125}I double antibody kit produced by Diagnostic Systems Laboratories, Inc. (Webster, TX). Sample and standard reactions were run in duplicate. Substrate (150 μl) was pipetted into borosilicate tubes, 100 μl of sample, and 50 μl of buffered saline. Standard reactions were run at concentrations of 19, 46, 116, 278, 694, and 1388 pmol/L T. Antiserum, diluted 1:3 (100 μl), and undiluted tracer (200 μl) were added to sample and standard tubes. Reactions incubated overnight for at least 18 h, after which precipitating reagent (400 μl) was added, and tubes were centrifuged and aspirated. The assays were sensitive to 14 pmol/L T.

Subjects were allocated, in order of identification number, into three lots. Interassay coefficients of variation were 28.8% for low pools and 11.0% for high pools. Although coefficients of variation for low concentrations are more sensitive to variance, sources of the high variance among low pools may also have included true differences between the first and second assays. Average low pool T concentrations were 159 pmol/L in the first assay, 239 pmol/L in the second, and 142 pmol/L in the third. Average sample concentrations from the first and second assays were 309 and 360 pmol/L T, respectively. Though not statistically different ($P = 0.12$), we assume that the differences reflect the interassay variation described above. Statistical control for that variation (by standardizing for assay) does not change the results presented in this article. The intraassay coefficient of variation was 11.5%. Testosterone concentrations reported in this article are the averages of duplicates.

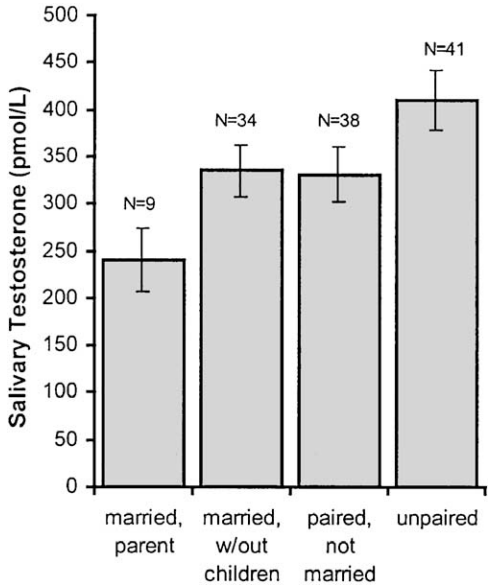

Fig. 1. Men in relationships, especially fathers, have lower T levels than unpaired men (values are mean testosterone ± SEM).

Results

"Paired" men had significantly lower T levels than "unpaired" men (one tailed t test, $P = 0.037$). Average T levels of married men were almost identical to T levels of paired men (Fig. 1). Men in committed, romantic relationships (married and paired combined, fathers included) had 21% lower testosterone levels than men not involved in such relationships ($P = 0.006$).

Relationship and marital status were surveyed independently. It is possible for a person to be married and yet not be in a committed relationship. In our sample, however, all married men indicated that they were in committed relationships.

The T levels of fathers, all of whom were married ($N = 9$), were 42% lower than unpaired men (one tailed t test, $P = 0.010$). They also had 28% lower T than paired or married men without children, but the small sample size did not provide enough power for this result to be statistically significant (one tailed t test, $P = 0.058$).

In this sample, T is uncorrelated with age ($P = 0.215$). Thus, for ease of interpretation, T levels are reported without adjusting for age.

Discussion

These results support the hypothesis that men involved in committed, romantic relationships have lower T levels than

unpaired men. Furthermore, the data suggest that being in such a relationship is the key correlate—not marital status. These are the first results directly supporting the notion that long-term pair bonds (and not just in the context of marriage) themselves are important predictors of male T levels. The data also lend support to the notion that fathering may be associated with lower T levels, although the small number of fathers prohibited meaningful comparisons with the T levels of paired nonfathers.

These results contribute to the small set of studies attempting to examine variation in T levels in view of male relationships such as pair bonds and fatherhood. By testing, and supporting, the hypothesis that such relationships would be associated with different T levels, the data provide more evidence suggesting this is a robust phenomenon. These results appear to be consistent with the "challenge hypothesis," which focuses on the role of elevations in T facilitating competitive male–male interactions that occur in reproductive contexts (Wingfield et al., 1990). The challenge hypothesis holds that elevated T during mating effort and lower T associated with paternal care represents a male tradeoff. It may also be that long-term mates and young offspring, behaving as active strategists, adaptively suppress male T levels in ways beneficial to themselves (and not just the males). By either logic, however, differences in male T levels can be viewed as reflecting and effecting variation in male mating and parenting effort.

The data raise additional questions. Considerable variation in marital interactions and parenting styles exists cross-culturally (Marlowe, 2000; Hewlett, 1992; Whiting and Whiting, 1975) and within the United States (Parke, 1996; Bozett and Hanson, 1991). It may be that this variation in marital and parenting relationships will yield different links to testosterone (no difference or less of an effect in sociocultural contexts characterized by less-affiliative pair bonds and reduced direct paternal care). Harvard Business School students might represent an extreme sociocultural data point in the degree of partner affiliation. Moreover, the percentage of difference in T levels observed in this study appears greater than the two military studies (Mazur and Michalek, 1998; Booth and Dabbs, 1993). Certainly, other factors could contribute to predicting and explaining sociocultural variation in testosterone-relationship patterns. Time of day (in which T measurements taken later in the day may yield stronger correlations with behavioral variables: Gray et al., 2002; Book et al., 2001), medium of T measurement (with salivary T results generating stronger correlations than serum T levels with behavior, e.g., Archer, 1991; but see Book et al., 2001), and age of participants (if variation in T levels declines with age, this reduces the chance of observing T differences associated with different relationships) could all affect the likelihood of observing T differences associated with different social relationships.

Importantly, our data do not directly speak to the issue of causation. We favor a reciprocal model of the interactions between T and behavior that seems most consistent with the body of existing data (Gray et al., 2002). High-T men may be less likely to enter stable, romantic relationships. Additionally, affiliative interactions with a partner may decrease T levels, in turn reducing mating effort. We also expect T variation within the group of paired men to be consistent with variation in mating effort, although we are not able to test this with our data set. For example, it may be that paired-male T levels will be highest during times of sexual activity with a partner (as suggested in Hirschenhauser et al., 2002) or that variation in the strength of the pair bond might explain variance in T levels among paired individuals. These are all topics for which longitudinal data would be of great help in teasing apart cause and effect.

While our study does not resolve the direction of causation, these results do provide a guide to the resolution. For those seeking to collect longitudinal data on relationships, our results provide a justification for studying unmarried couples. To the extent that unmarried relationships form and dissolve much more rapidly than do marriages, studying pair-bonded, but unmarried couples will be much faster and cheaper than studying married couples.

These results suggest two implications for current research into male reproductive health. One builds on the observation that being married is commonly associated with reduced morbidity and mortality, within the United States and a number of other countries (Hu and Goldman, 1990). Given that T may impair immune function (Campbell et al., 2001; Klein, 2000) and encourage risk taking (Daly and Wilson, 1999), these results suggest that bonding status—not marital status—may be a more salient demographic predictor of health outcomes. Common law marriages are rapidly increasing in the United States and Europe, and this pair bonding may be associated with some of the same protective health factors as marriage. A second implication is to consider the potential social costs of T manipulations. Increasingly, the medical community is weighing the costs and benefits of T replacement therapy among aging men. If different T levels reflect adaptive behavioral responses to varying relationships, then elevating T levels may cause men to engage in increased mating effort, raising the possibility of social costs attendant to T administration.

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References

Archer, J., 1991. The influence of testosterone on human aggression. Br. J. Psychol. 82, 1–28.

Berg, S.J., Wynne-Edwards, K.E., 2001. Changes in testosterone, cortisol, estradiol levels in men becoming fathers. Mayo Clin. Proc. 76, 582–592.

Book, A.S., Starzyk, K.B., Quinsey, V.L., 2001. The relationship between testosterone and aggression: a meta-analysis. Aggres. Viol. Behav. 6, 579–599.

Booth, A., Dabbs, J.M., 1993. Testosterone and men's marriages. Soc. Forces 72, 463–477.

Bozett, F.W., Hanson, S.M.H. (Eds.), 1991. Fatherhood and Families in Cultural Context, Springer verlog, New York.

Buena, F., Swerdloff, R.S., Steiner, B.S., Lutchmansingh, P., Peterson, M.A., Pandian, M.R., Galmarini, M., Bhasin, S., 1993. Sexual function does not change when serum testosterone levels are pharmacologically varied within the normal male range. Fertil. Steril. 59, 118–123.

Campbell, B., Lukas, W., Campbell, K., 2001. Reproductive ecology of male immune function and gonadal function, in: Ellison, P.T. (Ed.), Reproductive Ecology and Human Evolution, Aldine, New York, pp. 159–178.

Daly, M., Wilson, M., 1999. Darwinism and the roots of machismo. Sci. Am. Pres. 10, 8–14.

Davidson, J.M., Carmargo, C.A., Smith, E.R., 1979. Effects of androgens on sexual behavior of normal men. J. Clin. Endocrinol. Metab. 48, 955–958.

Fleming, A., Corter, C., Stallings, J., Steiner, M., 2002. Testosterone and prolactin are associated with emotional responses to infant cries in new fathers. Horm. Behav. 42, 399–413.

Gray, P.B., Kahlenberg, S.M., Barrett, E.S., Lipson, S.F., Ellison, P.T., 2002. Marriage and fatherhood are associated with lower testosterone in males. Evol. Hum. Behav. 23, 193–201.

Hewlett, B.S., 1992. Father-Child Relations. Aldine, New York.

Hirschenhauser, K., Frigerio, D., Grammer, K., Magnusson, M.S., 2002. Monthly patterns of testosterone and behavior in prospective fathers. Horm. Behav. 42, 172–181.

Hu, Y., Goldman, N., 1990. Mortality differentials by marital status: an international comparison. Demograph 27, 233–250.

Klein, S., 2000. Hormones and mating system affect sex and species differences in immune function among vertebrates. Behav. Proc. 51, 149–166.

Marlowe, F., 2000. Paternal investment and the human mating system. Behav. Proc. 51, 45–61.

Mazur, A., Booth, A., 1998. Testosterone and dominance in men. Behav. Brain Sci. 21, 353–363.

Mazur, A., Michalek, J., 1998. Marriage, divorce and male testosterone. Soc. Forces 77, 315–330.

Mazur, A., Mueuller, U., Krause, W., Booth, A., 2002. Causes of sexual decline in aging married men: Germany and America. Int. J. Impot. Res. 14, 101–106.

Parke, R.D., 1996. Fatherhood. Harvard University Press, Cambridge, MA.

Storey, A.E., Walsh, C.J., Quinton, R.L., Wynne-Edwards, K.E., 2000. Hormonal correlates of paternal responsiveness in new and expectant fathers. Evol. Hum. Behav. 21, 79–95.

Wang, C., Swerdloff, R.S., Iranmanesh, A., Dobs, A., Snyder, P.J., Cunningham, G., Matsumoto, A.M., Weber, T., Berman, N., 2000. Transdermal testosterone gel improves sexual function, mood, muscle strength, and body composition parameters in hypogonadal men. J. Clin. Endocrinol. Metab. 85, 2839–2853.

Whiting, J., Whiting, B., 1975. Aloofness and intimacy of husbands and wives: a cross-cultural study. Ethos 3, 193–207.

Wingfield, J.C., Ball, G.F., Dufty, A.M., Ball, G.F., 1990. The "challenge hypothesis:" theoretical implications for patterns of testosterone secretion, mating systems, and breeding strategies. Am. Nat. 136, 829–846.