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Short Report

No Place Like Home: Testosterone Responses to Victory Depend on Game Location

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ABSTRACT Several studies have demonstrated that a variety of factors influence testosterone responses to competitive interactions. This study examined the extent to which game location would influence testosterone responses to human competition. Male amateur ice hockey players (n = 10) provided saliva samples before and after competing against the same opponent on two separate occasions (one game at home and one game away). Although both games resulted in similar victories, the home victory was associated with a significantly larger rise in testosterone concentrations relative to the away victory. The factors responsible for the different testosterone responses are not known, however, it is possible that a rise in status in front of the home crowd is more rewarding to athletes, and thus, a more potent stimulus for the endocrine system. Am. J. Hum. Biol. 21:392–394, 2009.

A number of studies demonstrate that testosterone concentrations are responsive to human competitive interactions (see Archer, 2006; Mazur and Booth, 1998; Salvador, 2005; van Anders and Watson, 2006 for reviews) and that these endocrine responses predict future competitive and aggressive behavior (Carré and McCormick, 2008; Carré et al., in press; Mehta and Josephs, 2006). In general, testosterone responses to competition are influenced by the outcome of the contest, with winners having elevated testosterone concentrations relative to losers (Elias, 1981; Mazur and Lamb, 1980; for meta-analysis see Archer, 2006). However, some studies also suggest that individual difference variables (e.g., power motive; Schultheiss et al., 2005; social anxiety; Maner et al., 2008), aggressive behavior (Carré and McCormick, 2008), attribution of success (Gonzalez-Bono et al., 1999), and individual performance ratings (Edwards et al., 2006; Gonzalez-Bono et al., 1999) may also exert an important influence on testosterone responses to competition.

Two studies have reported that men have higher testosterone concentrations prior to home relative to away games (male soccer players; Neave and Wolfson, 2003; male ice hockey players; Carré et al., 2006). However, one question not addressed in both studies was whether testosterone responses to victory and defeat would also vary as a function of game location. In the study of ice hockey players, a direct comparison of testosterone responses from home and away victories was not possible because the team only won a single game. Likewise, an appropriate comparison of the home versus away defeats could not be made because the margin of defeat varied across home and away games. Thus, it is currently unknown whether game location would exert an influence on testosterone responses independent of competition outcome.

In this study, data were collected from two games played against the same opponent, at the same time of day and resulting in similar outcomes (away game, 5–3 win; home game, 4–3 win). This relatively balanced design enabled a comparison of testosterone concentrations (pre and post game) as a function of game location. It was predicted that testosterone concentrations would be higher prior to the home versus away game (Neave and Wolfson, 2003; Carré et al., 2006). Although I made no specific prediction regarding differences in testosterone responses as a function of game location, it is conceivable that a victory in front of a supportive audience (i.e., home crowd) may exert a different effect on the endocrine system than a victory occurring in front of an unsupportive and/or neutral crowd (i.e., away crowd).

METHODS

Participants

Participants were 14 men (mean age = 16.29, SD = 0.83) from an amateur (nonelite) hockey team located in Northern Ontario. Four members of the team provided saliva samples for only one of the two games, and thus, were not included in the analysis. The study was approved by the Brock University Research Ethics Board.

Materials and procedure

All participants provided saliva samples 45 min before and 10 min after two games (away game in December; home game in February). The away game was played ~30 min from the team's home venue. Participants did not report using any prescription medications during the time of testing. Furthermore, participants were asked to refrain from eating any large meals 1 h before providing saliva samples. Both games took place between 18h00 and 21h00 and took approximately the same amount of time to

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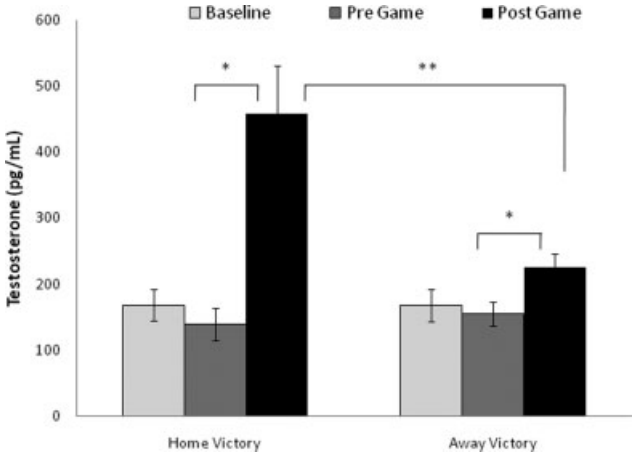

Fig. 1. Mean (SEM) baseline, pre- and post- competition testosterone concentrations for home and away victories ($n = 10$). Note: *$P < 0.01$, **$P = 0.01$.

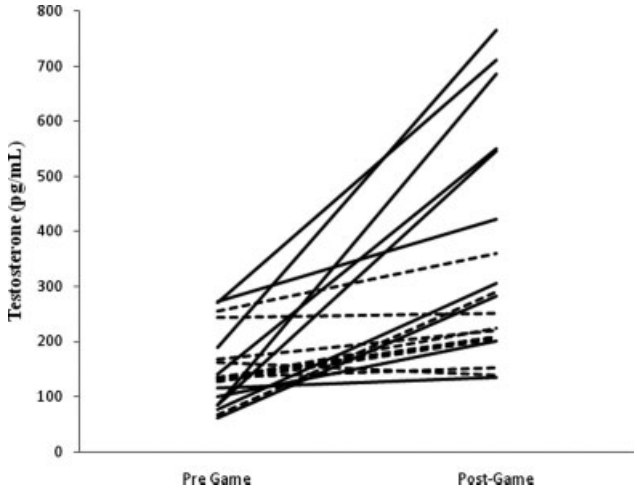

Fig. 2. Pre- and post- game testosterone concentrations from each participant for the home victory (solid lines) and away victory (dotted lines).

complete (2 h). Performance ratings were obtained from the head coach and ranged from 1 to 4 (1 = poor performance to 4 = excellent performance). In addition, saliva samples were obtained from two rest days at 18h00 (both samples were obtained one day prior to each game) and served as baseline samples.

Saliva samples were put on ice immediately after collection, transported to the laboratory and stored at −20°C. Samples were assayed in duplicate and ran in the same batch. The intra-assay coefficient of variation was 4.73%. A full description of the assay protocol has been described previously (Carré et al., 2006).

Analysis

Statistical analyses consisted of Pearson correlations and a repeated measure analysis of variance (ANOVA) with follow-up paired t-tests (for within subject comparisons). An alpha level of $P < 0.05$ was used to determine statistical significance.

RESULTS

There were no differences in performance ratings for the home victory and away victory (Away Victory; Mean = 3.23, SD = 0.35: Home Victory; Mean = 2.92, SD = 0.38, $t_9 = 1.56, P = 0.15$).

A two (game location: home vs. away) by three (time: baseline vs. pre- vs. post- game testosterone) repeated measures ANOVA revealed main effects of location ($F_{1,9} = 6.10, P = 0.04$) and time ($F_{2,18} = 21.04, P < 0.01$) and a time by location interaction ($F_{2,18} = 9.29, P = 0.002$) (See Figures 1 and 2). The results did not change when the analysis was performed using log-transformed testosterone values. There were no significant increases in testosterone concentrations from baseline to precompetition for home ($t_9 = 1.16, P = 0.27$) or away ($t_9 = 0.45, P = 0.66$) games. There was no difference in pregame testosterone concentrations between home and away games ($t_9 = 0.47, P = 0.65$). There was a significant pre- to post- competition rise in testosterone concentrations for both home ($t_9 = 4.87, P = 0.001$) and away ($t_9 = 3.31, P = 0.009$) games. However, postcompetition testosterone concentrations were higher for the home compared with the away victory ($t_9 = 3.14, P = 0.01$).

There were no significant correlations between change in testosterone (calculated as percent change: post T—pre T/pre T * 100) and individual performance for home ($r = -0.06, P = 0.87$) or away ($r = -0.23, P = 0.52$) victories.

DISCUSSION

The main finding from the current study is that testosterone responses to victory varied as a function of game location. More specifically, men had higher postgame testosterone concentrations after a victory in their home versus opponents' venue.

There was no evidence for an influence of game location on pregame testosterone concentrations. This finding conflicts with previous reports indicating that men have higher testosterone concentrations prior to home versus away games (Neave and Wolfson, 2003; Carré et al., 2006). One difference between the two studies with hockey players is that the current study examined nonelite (or novice) hockey players, whereas the previous study examined elite-level hockey players, a difference that has been found to influence endocrine responses to competition (Kivlighan et al., 2005).

The different testosterone responses for home and away victories cannot be attributed to variation in performance, as the margins of victory and performance ratings were similar for both games and there were no associations between change in testosterone and performance. One potential explanation for this finding may have to do with the composition of the home versus away crowd. A rise in status (i.e., competitive victory) in front of friends and family members may be an especially potent stimulus for the endocrine system. In fact, one study found that performance in the presence of a supportive audience (compared to a neutral or adversarial audience) was associated with lower levels of stress (self-report) and better mood

ratings following the task (Butler and Baumeister, 1998). Thus, it is possible that the victory at home may have been associated with a positive mood and a reduction in stress, which may in turn have mediated the effect observed in the current study. Although speculative, this possibility could be examined more systematically by assessing the size and composition of the crowd (e.g. how many friends and family members in attendance) or the extent of positive/negative support provided by the crowd (e.g. cheers and/or "boos" when the team scores).

There are some limitations to the study that warrant discussion. First, this study was conducted with a relatively small sample size that may limit its generalizability. Also, the study did not take into account the potential influence of physical exertion on testosterone responses (although this confound was minimized by comparing data from two games with very similar outcomes). Last, an order effect (i.e., the order in which the home and away victories occurred) cannot be ruled out as a potential source of variation in testosterone responses, and should be considered in future studies.

Despite these limitations, the current study highlights the importance of considering game location when conducting research on the relationship between competition and endocrine responses in natural settings (e.g., sports). Future research may wish to examine the extent to which factors such as spectator dynamics can explain the differential endocrine responses observed here.

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