Study of testosterone reactivity and its variance in response to skydiving

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Abstract
The purpose of this study was to examine whether the sex hormone testosterone was reactive to an exciting, potentially life-threatening situation: skydiving from 14,000 feet. Participants included 32 males and 12 females who provided repeated saliva samples before and after jumping as well as on a baseline day. We saw that the sex hormone testosterone changes dramatically in response to an exciting situation like skydiving. These changes are observed despite the overall stability in testosterone from one individual to another. Findings contrast with a previous study that found salivary testosterone was significantly lower on a jump day and were especially low prior to skydiving², but fit with an emerging perspective of testosterone as reactive to an individual’s social context.

Introduction
Testosterone is a steroid hormone that is highly similar in structure to estrogen which predominates in females. This predominantly sex hormone acts on various genomic and non-genomic pathways with help of its functional metabolite dihydrotestosterone (DHT)¹ to affect broad consequences for diverse social emotional processes. In the past, people have been attributed to being either high or low in testosterone, which affects their behavior. However, recent advances in neuroendocrinology has revealed that testosterone reacts within individuals depending on their social context and well. For example, one study looked at the testosterone reactivity to skydiving and found that testosterone was significantly lower on jump day than basal day². This investigation is in contrast with a wider literature that supports the “Challenge Hypothesis” which states that testosterone reacts to perception of emotional or social challenge¹. We conceptualize skydiving as both an emotional and social challenge, as well as a life threatening situation. We predicted that testosterone levels would change within participants in response to skydiving and comparing the jump day to the basal day.

Testosterone levels and reactivity was also compared with respect to gender. Consistent with its role as a sex hormone, we expected testosterone levels would be higher in males than females. This could be explained by the fact that males can produce more testosterone than females. Also, the amount of androgen receptors in brain is much higher in males than in females which could also lead to higher reactivity of males than females¹. We explored whether the reactivity of testosterone in males and females is also different, but too few studies have simultaneously compared reactivity in males and females to make a directional hypothesis.

Methods
44 participants (aged 18-49; M= 24±4.6) were recruited from Goldcoast Skydivers Company. They consisted of 73% male (N= 32) with a mean age of 32.12 ± 8.50 years. The remaining 27% were females (N=12) with a mean age of 27.08 ± 5.76 years. Individuals were only considered if they had pre-existing desire to skydive and had no obvious health complication. Participants boarded the plane, ascended to 14,000 feet and jumped (Mtime = 2:12 pm). Saliva samples were collected from the individuals during basal day and jumping day. Each participant gave 10 spit samples; 5 on jumping day and 5 on basal day at the same times of day as the jump day. The spit samples were collected 1 hour before jump, 30 minutes before jump, immediately after the jump, 30 minutes after the jump, and an hour after the jump. The testosterone level in the saliva was measured using a well-validated enzyme immuno-assay (www.silmetrics.com) in the SPIT laboratory. HLM analyses were used to capture the individual differences and gender differences in testosterone reactivity throughout each time interval, simultaneously considering within individual testosterone levels and between individual testosterone differences.

Result
Testosterone Reactivity across jump and basal day:
The graph shows the testosterone level at different time points between jump and basal day. Here, we see that the testosterone level stays relatively same during the basal day whereas we see a definite reaction to skydiving during the jump day. Testosterone was highly stable within an individual, \( \chi^2(29)=1198.8, p<.0001 \), with 88.75% of the total testosterone variance due to between individual differences. Testosterone showed momentary changes as well. Testosterone changed dramatically in response to skydiving, rising from the start of the experiment until the jump, \( B=10, p<.0001 \), and then declined significantly after the jump, \( B=-10, p<.007 \).

Overall, testosterone was not different between jump and basal days, \( B=-0.3, p=.74 \), but there was substantial variation in the basal-day effect, suggesting some individuals had higher while others had lower testosterone on the jump day compared to basal testosterone, \( \chi^2(29)=221.06, p<.0001 \).

Testosterone Reactivity between males and females:
The graph shows the testosterone level at different time points between jump and basal day when compared by gender. Here, we see that the testosterone level for males is higher than females on basal days. Even during the jump day the testosterone peak is higher in male than in female. Also, we see that the testosterone rise is steeper in males than in females. Males had significantly higher testosterone levels, \( B=1.09, p<.0001 \), and showed greater testosterone reactivity than females, \( B= -0.07, p<.025 \).

Conclusion
HLM analysis showed that there is significant response to skydiving among different individuals which was mostly due to between individual differences i.e. that the different testosterone levels were due to the difference in people themselves. These individual differences might be the personality differences and further investigation needs to be done to examine these individual differences. Furthermore, it was seen that there greater testosterone reactivity within males than in females in response to skydiving. This might be due to males having higher testosterone production rate than females. This study is the first to demonstrate gender differences in testosterone reactivity to skydiving.

References