Adolescence and Stress: Negative Outcomes in Adult Function and Mental Health

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Youth are heated by Nature as drunken men by wine.
- Aristotle
The Health Paradox of Adolescence

By adolescence, individuals have matured beyond the frailties of childhood, yet have not begun any of declines associated with adult aging.

Stronger
Bigger
Faster
Increases in...
Reaction time
Reasoning abilities
Immune function
Withstand...
Cold
Heat
Injury

Morbidity and mortality rates *increase* 200%-300% over the same interval of time
Puberty is a period developmental vulnerability

- Emergence of psychopathologies
  - Anxiety Disorders
  - Depression
  - Schizophrenia
  - Eating Disorders
- Risky behavior
  - Drug use and abuse
Gray and white matter changes during pubertal development in humans

Giedd et al. 1999 *Nature Neuroscience*

Giedd, 2004 *Ann NY Acad Sci*
Hypothalamic-Pituitary-Adrenal Axis

CRH → ACTH → CORT

Hypothalamus
(-)
Hippocampus
Amygdala
Prefrontal Ctx

Pituitary

Adrenal

Kidney

CORT
Adaptive responses to stress

- increase available energy
- increase oxygen intake
- decrease blood flow to digestion
- stimulate immune system
- inhibit reproduction
- enhance memory
Pathological responses to chronic stress

- increase available energy
- increase circulation
- decrease blood for digestion
- stimulate immune system
- inhibit reproduction
- enhance memory

- increased risk for diabetes
- high blood pressure
- chronic bowel syndrome
- inhibit immune system
- decrease libido and fertility
- impair memory
- neural damage/remodeling
Stress-induced dendritic remodeling in adults

CONTINUE TO MATURE DURING ADOLESCENCE!!!
Stress Burden and the Lifetime Incidence of Psychiatric Disorders in Young Adults

R. Jay Turner, Ph.D. and Donald A. Lloyd, Ph.D.
Archives of General Psychiatry (2004); 61:481-488

Stress burden during adolescence was strongly correlated with subsequent onset of depressive and/or anxiety disorders in adulthood.
Are prepubertal and adult stress responses different?

Days of age

Blood Sampling Time Point
Basal, 0 min, 30 min, 60 min, 120 min

Prepubertal
Adult

(30 min session)

21 28
70 77
Prepubertal animals do not shut off stress response

Romeo et al, 2004 *Neuroendocrinology*
Do experience and development interact?

Days of age

1 Day

21 Prepubertal
28 Adult
70

(30 min session)

7 Days

21 Prepubertal
28 Adult
70
77

(30 min session/day)
HPA Plasticity: Experience and development interact to affect stress responsiveness

Romeo et al., 2006 Endocrinology
Does stress affect behavior?

<table>
<thead>
<tr>
<th>Record</th>
<th>Stress</th>
<th>Record</th>
</tr>
</thead>
<tbody>
<tr>
<td>30 min</td>
<td>30 min</td>
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</table>

Play behavior is inhibited after exposure to stress

![Graph showing play behavior frequency before and after stress](image-url)

- Play / Pins
- Frequency
- Pre-Stress: 20
- Post-Stress: 0

* indicates significant difference
Conclusions

• Adolescence is associated with dramatic changes in hormonal stress reactivity, and can be modulated by stress history of the animal.

• Stress profoundly affects social behaviors in adolescent animals.

• Though there appears to be a link between pubertal exposure to stress and later psychological dysfunction, the mechanisms that mediated this relationship remain elusive.
“What you know is nothing, little man; what you need to learn, immense.”

-Charles Dickens
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Cortical maturation during adolescence

Gogtay et al, 2004 Proceedings of the National Academy of Sciences
• Prepubertal animals show higher levels of anxiety than adults

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<thead>
<tr>
<th>Latency to Center (sec)</th>
<th>Prepubertal</th>
<th>Adult</th>
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<tr>
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