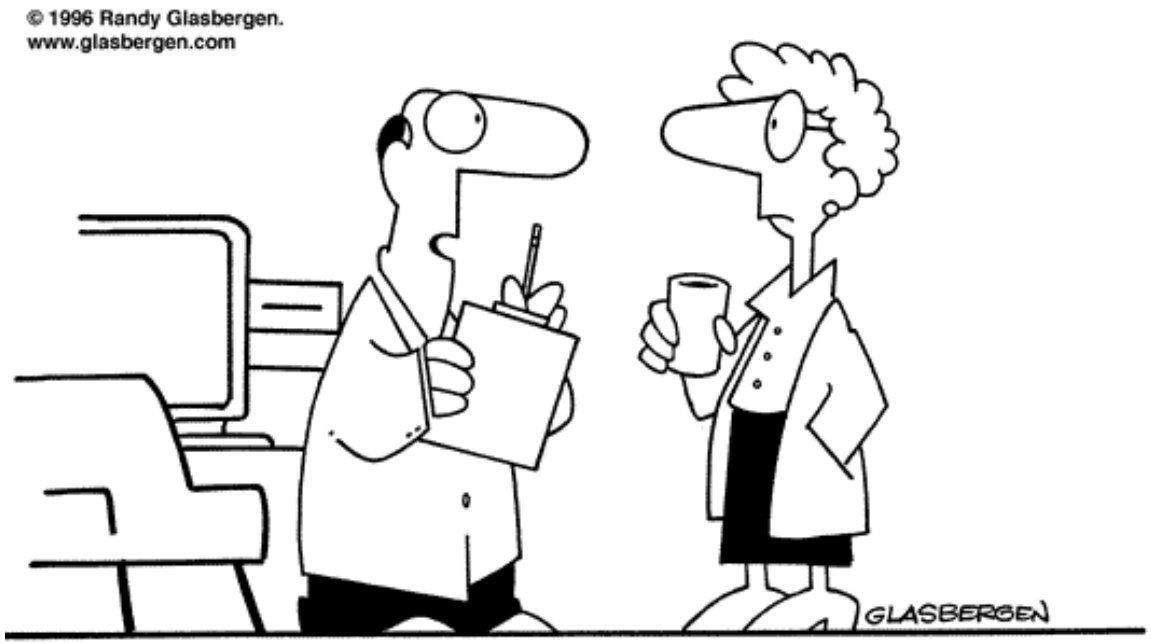
Mechanisms of Stress

Presented to: Biological Mechanisms of Health



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Outline of Talk

1. Stress: a useful concept?
2. A Stage Model of Stress and Disease
3. The Stress-Response System
4. Measuring Activity of the HPA axis
5. Some empirical examples from our lab
6. Q&A

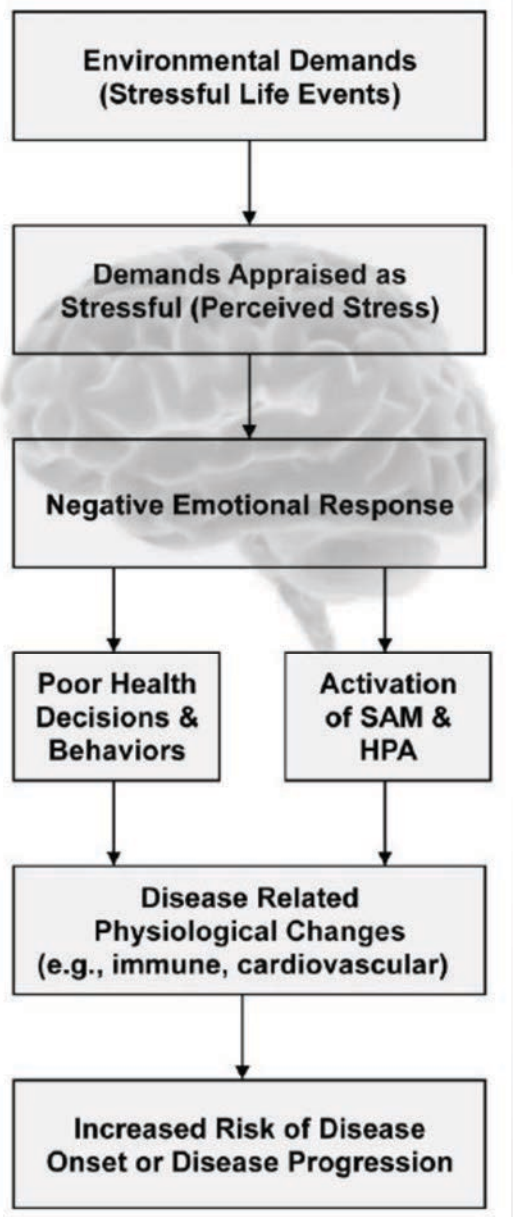
Traditions in the study of stress (Cohen et al., 2016)

- Stress as an overly permissive term (Kagan et al., 2016)
  - Seyle defined stress as a nonspecific response of the body to deviant condition, that is a condition (pleasant or unpleasant) that demands an adjustment or adaptation by the organism.
  - Rising from a chair, preparing for a wedding, the death of a loved one are all stressors.
  - Is "stress" a useful concept? Is there any agreement to what the characteristics of a stressors are? (Cohen et al., 2019)

- Three solutions
  - Koolhaas et al., 2011 → stressors are unpredictable and/or uncontrollable.
  - McEwen and McEwen, 2016 → distinguish between good, tolerable, and toxic stress.
  - Cohen et al., 2016 → a stage model of stress and disease

A Stage Model of Stress and Disease (Cohen et al., 2016)

- Definition of stress
- Traditions in the study of stress
  - Epidemiologic tradition
  - Psychological tradition
  - Biological tradition
    - Mechanisms of stress
- A Stage Model of Stress and Disease
- Important implications (Cohen et al., 2019)
  - Stressful events can impact most diseases
  - Bidirectional relationship
  - Exposure to stressors does not necessarily make you sick – psychological and social resources can promote resilience



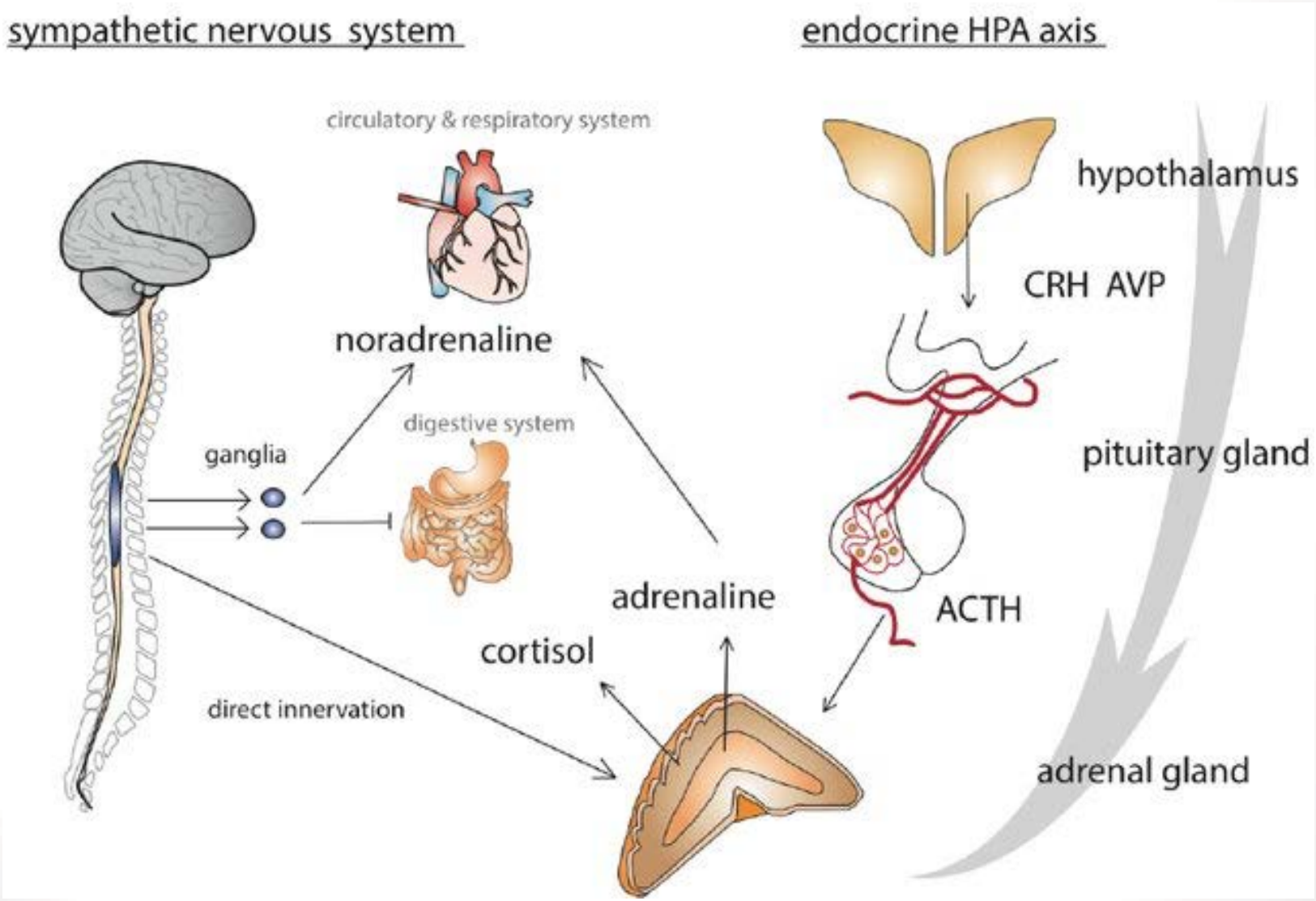
The Stress Response System (Del Giudice et al., 2012)

- SRS comprises the autonomic nervous system and hypothalamic-pituitary-adrenal axis

- Main function:
  - Coordinate the organism's behavioral and physiological responses to environmental challenges (threats and opportunities)

- How does the SRS work?
  1. The SRS response is hierarchical (i.e. layers of response)
     1. Parasympathetic withdrawal
     2. Sympathetic activation
     3. HPA activation
  2. The components of the SRS interact with each other

Hierarchical Organization of SRS



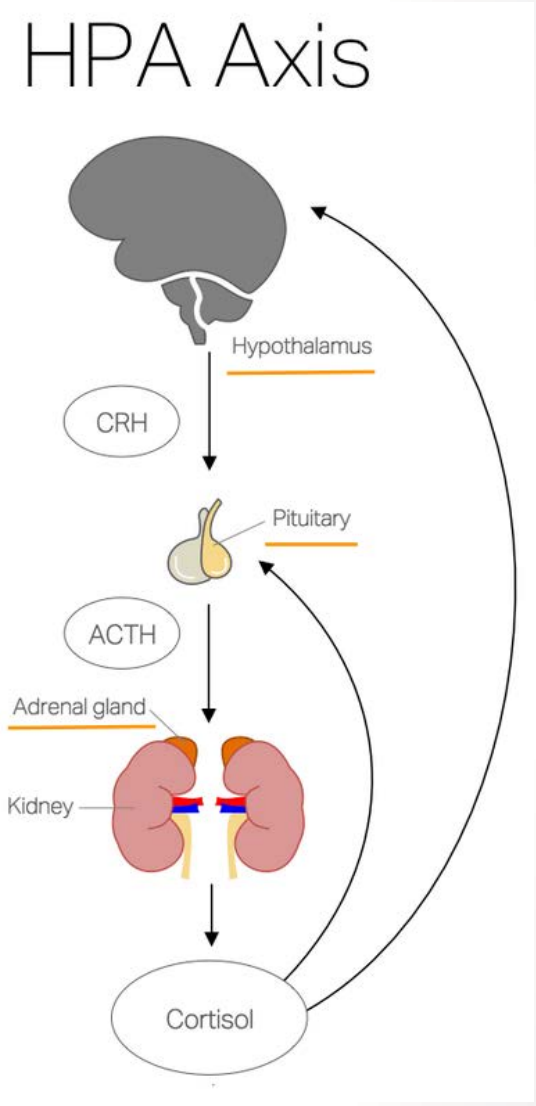
Even et al., 2012

The HPA axis

- HPA functions in response to stress:
  1. mobilize physiological and psychological resources (e.g., energy release, alertness and vigilance, and memory sensitization).
  2. counter-regulate the physiological effects of sympathetic activation (i.e., recovery facilitation).

- Sensitive to social, emotional and psychological events

- HPA axis has a central role in regulating many homeostatic systems in the body (e.g., immune system) → implications for health (short-term and long-term), including mortality



https://mplsimc.com/2017/11/16/tired-burnt-out-need-a-sabbatical-the-science-of-adrenal-fatigue/hpa-axis-diagram/

Measuring activity of the HPA axis (part 1)

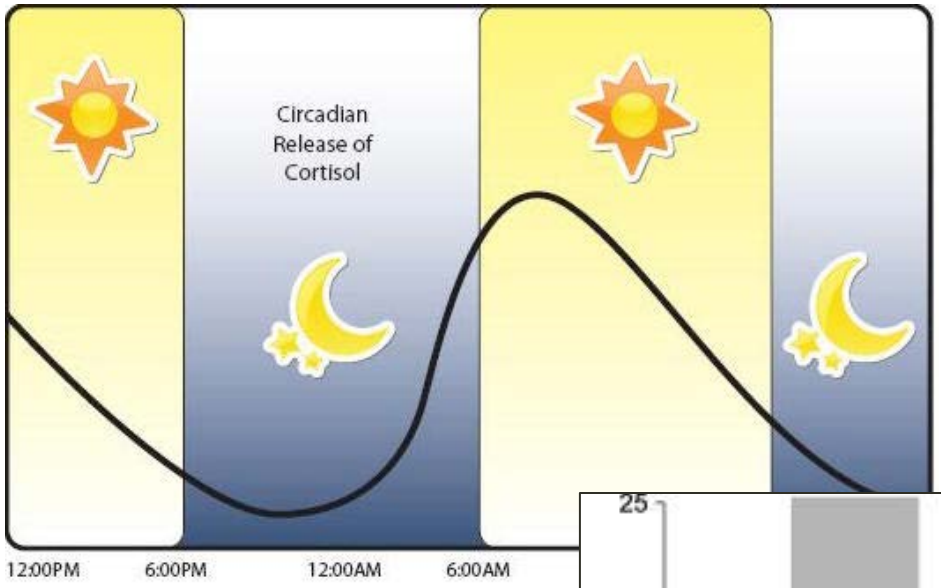
- Blood Cortisol – bound and unbound cortisol -
- Salivary Cortisol - biologically active, unbound cortisol -
  - Reflects HPA activity in past 10 – 60 mins
- Urine cortisol - bound to carrier proteins
  - Reflects boarder profile of HPA activity
- Hair/Nail cortisol - biologically active, unbound cortisol
  - Reflects boarder profile of HPA activity
- Cerebrospinal fluid CRH
- Blood ACTH
- Glucocorticoid Sensitivity
  - How sensitive the tissue is to cortisol's regulation
  - Higher number of glucocorticoid receptors in cell → more sensitive to cortisol
  - When more cortisol circulating (chronic stress) → cells downregulate number of receptors (maintain homeostasis) → sensitivity to glucocorticoids diminished → negative feedback inhibited

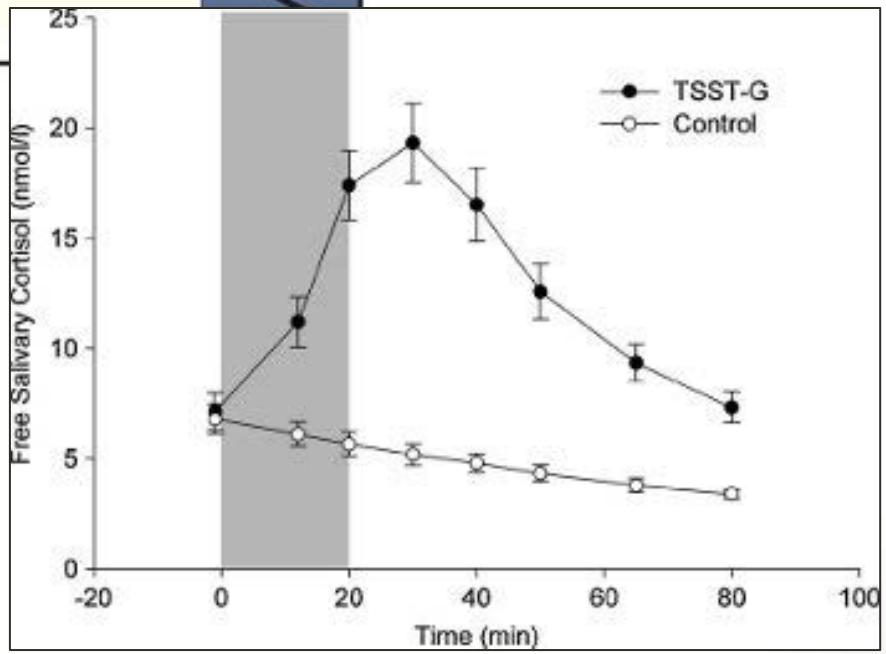
Measuring activity of the HPA axis (part 2)

- Administration of:
  - CRH (to examine pituitary function) → Measure ACTH and cortisol 1 – 2 hours after administration
  - ACTH (adrenal function) or dexamethasone (pituitary function) → Measure cortisol 8 – 17 hours after administration

- Generally:
  - Normal when challenge molecule suppresses circulation of target hormone
  - Abnormal/dysregulated when there is no influence

Measuring Daily Cortisol vs. Cortisol Reactivity





https://www.t-nation.com/living/tip-3-ways-to-beat-chronic-stress & *Vors et al., 2019*

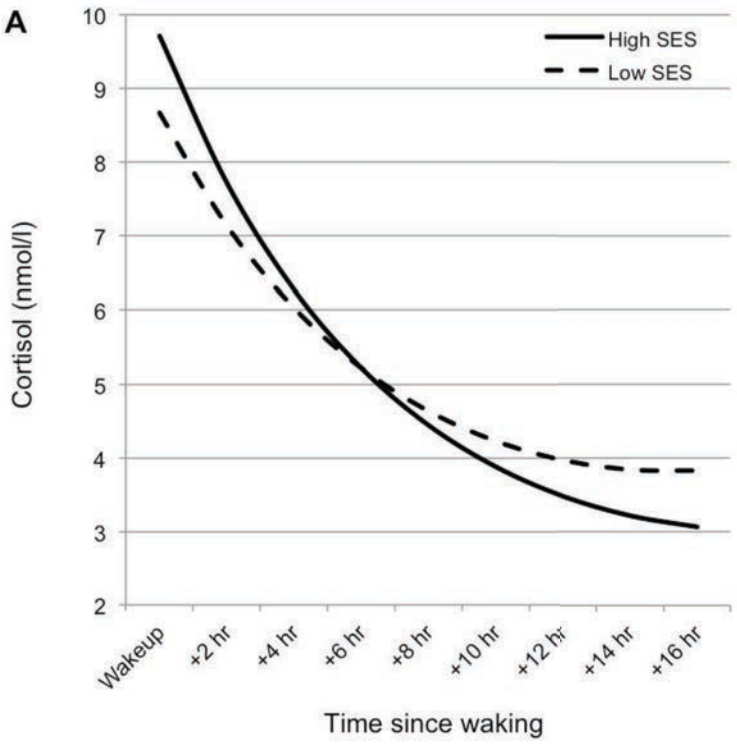
Some empirical examples from our lab (part 1)

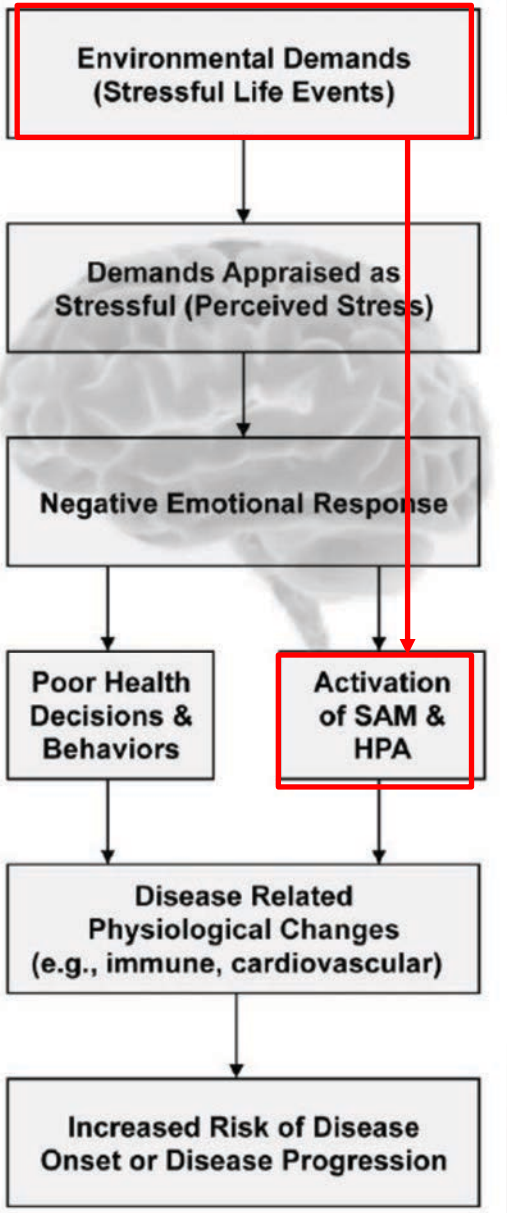
Socioeconomic Status, Ecologically Assessed Social Activities, and Daily Cortisol Among Older Urban African Americans

Journal of Aging and Health
1–22

DOI: 10.1177/0898264319856481
journals.sagepub.com/home/jah
SAGE

Samuele Zilioli, PhD[1,2], Heather Fritz, PhD[3,4], Wassim Tarraf, PhD[3,4], Susan A. Lawrence, PhD[5], and Malcolm P. Cutchin, PhD[3,4]





Some empirical examples from our lab (part 2)

Perceived Stress is Linked to Heightened Biomarkers of Inflammation via Diurnal Cortisol in a National Sample of Adults

Erik L. Knight[1,2*], Jaqueline Rodriguez-Stanley[3], Yanping Jiang[3], David M. Almeida[1,4], Christopher G. Engeland[1,5], Samuele Zilioli[3,6*]

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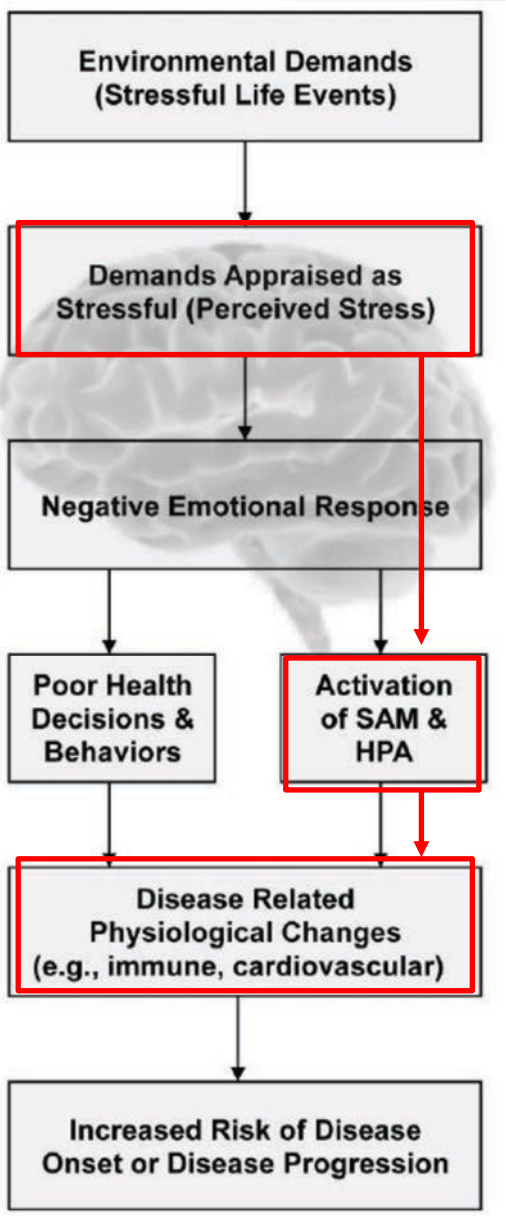
	Cortisol to Inflammation Path		Estimate of Indirect Path (PSS to cortisol to inflammation)		
	Estimate, ω	95%CI	Estimate, ω	95%CI	Standardized Estimate (ω_{STD})
CRP	0.176	[0.007, 0.346]	0.001	[0.000, 0.003]	0.006
IL-6	0.220	[0.122, 0.338]	0.001	[0.0002, 0.003]	0.012
Fibrinogen	0.204	[0.062, 0.357]	0.001	[0.0001, 0.003]	0.008
E-Selectin	0.091	[-0.049, 0.229]	0.001	[-0.0003, 0.002]	0.004
ICAM-1	0.134	[0.000, 0.264]	0.001	[0.000, 0.002]	0.006



Some empirical examples from our lab (part 3)

Perceived Social Support and Children's Physiological Responses to Stress: An Examination of the Stress-Buffering Hypothesis

Chen, Lihua; Zilioli, Samuele; Jiang, Yanping; Wang, Xiaolei; Lin, Danhua Less

Psychosomatic Medicine. Post Acceptance: October 14, 2020

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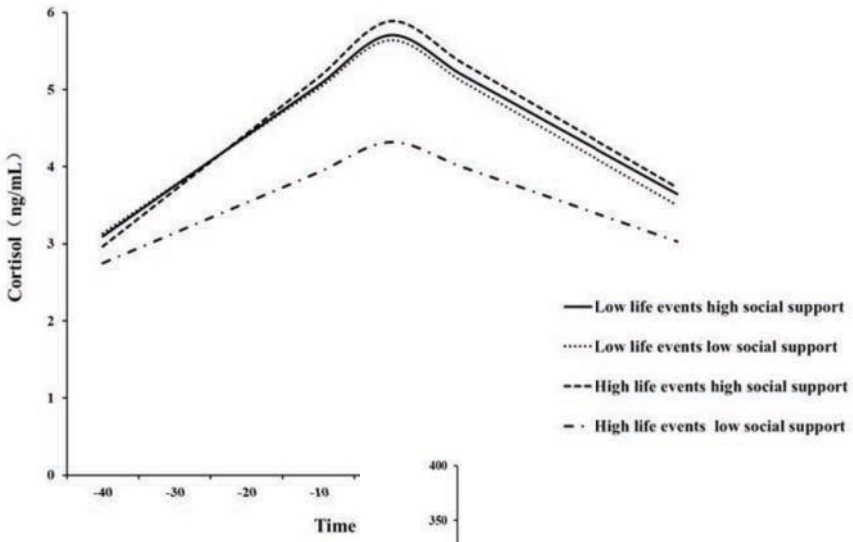

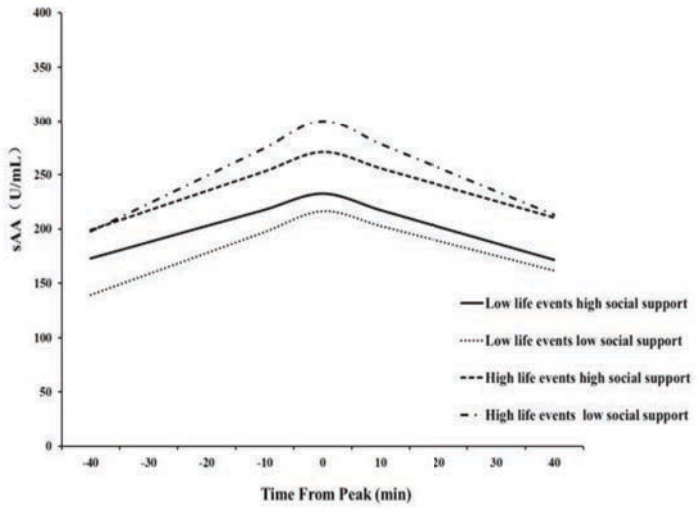

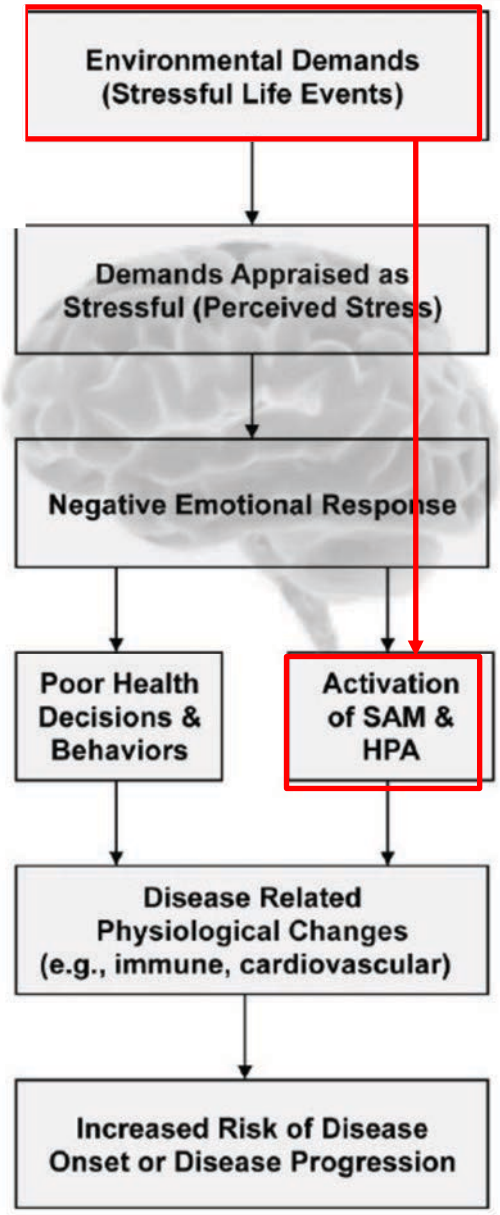

Acknowledgments


thank you
danke
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謝謝
ngiyabonga
teşekkür ederim
Баярлалаа
спасибо
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merci