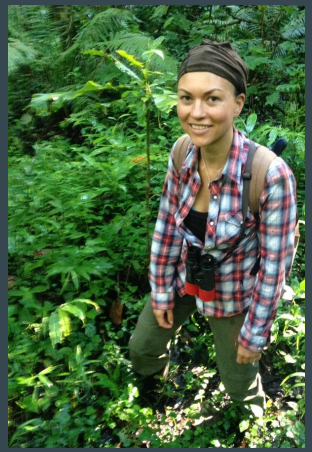
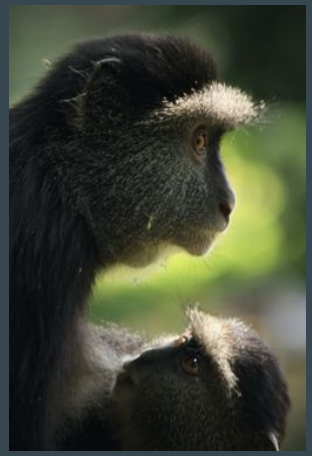
ANTH 197 MS
Biomarkers in the Social Sciences

...

Prof. Thompson González

Who am I?





I'm a primate behavioral ecologist.

I use biomarkers, behavioral observations, and demographic data to evaluate

- Social & physical changes with age & exposures
- The hidden costs and benefits of sociality

Stronger social bonds do not always predict greater longevity in a gregarious primate

Nicole A. Thompson[1,2] | Marina Cords[1,2]

Urinary markers of oxidative stress respond to infection and late-life in wild chimpanzees

Nicole Thompson González[1,2]*, Emily Otali[3], Zarin Machanda[4,3], Martin N. Muller[1,3], Richard Wrangham[5,3], Melissa Emery Thompson[1,3]

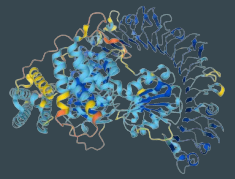
What are biomarkers?

A biological measure of a biological state.

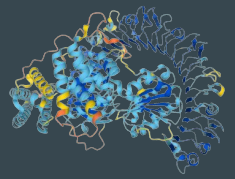
“A characteristic objectively measured and evaluated as an indicator of normal biological processes, pathogenic processes, or pharmacological responses to a therapeutic intervention”

- National Institutes of Health

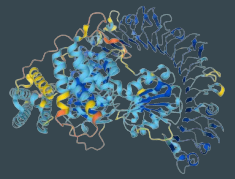
Physiological Process



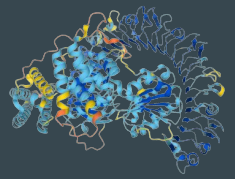
Physiological Process



(Basic research)



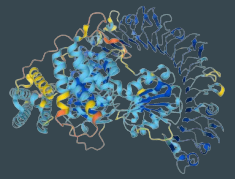
Clinical
Outcome



Clinical
Outcome

(Clinical diagnostics)

Physiological Process

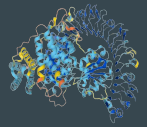


Clinical Outcome

Differences between “clinical” biomarkers and others

Clinical setting:

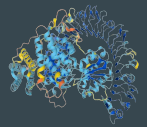
Biomarker predicts Clinical outcome



- Heart attack
- Stroke
- mortality

Non-clinical setting:

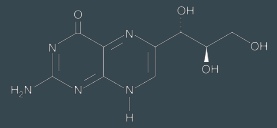
Biomarker indicates Physiological state



- Energy balance
- Reproductive state
- Infection

Neopterin

Physiological Process

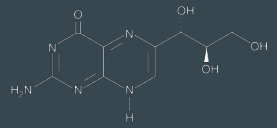


Clinical Outcome

Activated macrophages through a Th1 immune response (IFNγ)

Physiological Process

Neopterin



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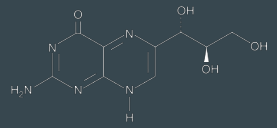


Neopterin

SLE
Ischemic heart disease
Atrial fibrillation

Clinical Outcome

HbA1C

Physiological Process

Clinical Outcome

Glycation of hemoglobin

HbA1C

Physiological Process → → Clinical Outcome

Glycation of hemoglobin

HbA1C

Risk of diabetes

Physiological Process

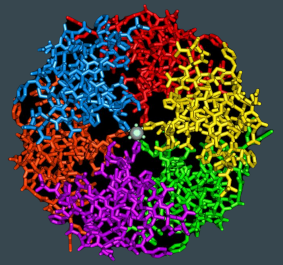
Clinical Outcome

What are biomarkers?

Physical attributes

- Height
- Body Mass Index
- Blood pressure
- Respiratory rate
- Skin fold thickness

What are biomarkers?



Physical attributes

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Biochemical actors

- Hormones
- Cytokines
- Cells (e.g. immune)
- Their by-products & metabolites

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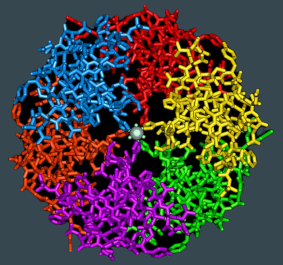

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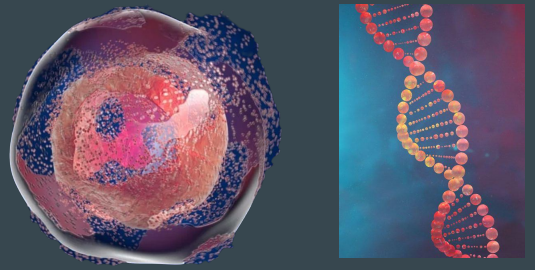


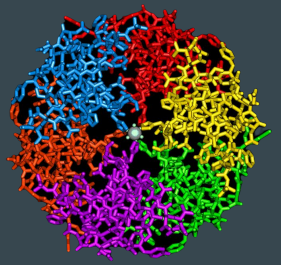
Others

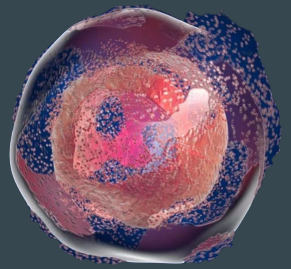
- Products of physical damage to cells, DNA, proteins, and lipids
- Particular alleles of genes

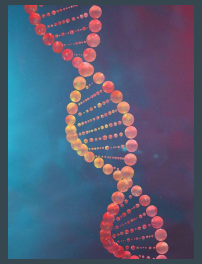
What are biomarkers?

"Dry"

"Wet"







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Perspectives: no biomarker is simply “good” or “bad”

Health

Physiological processes relative to a standard or baseline

So what is healthy?

Have to gather evidence for baselines, pair variation with outcomes, make choices about significant deviations

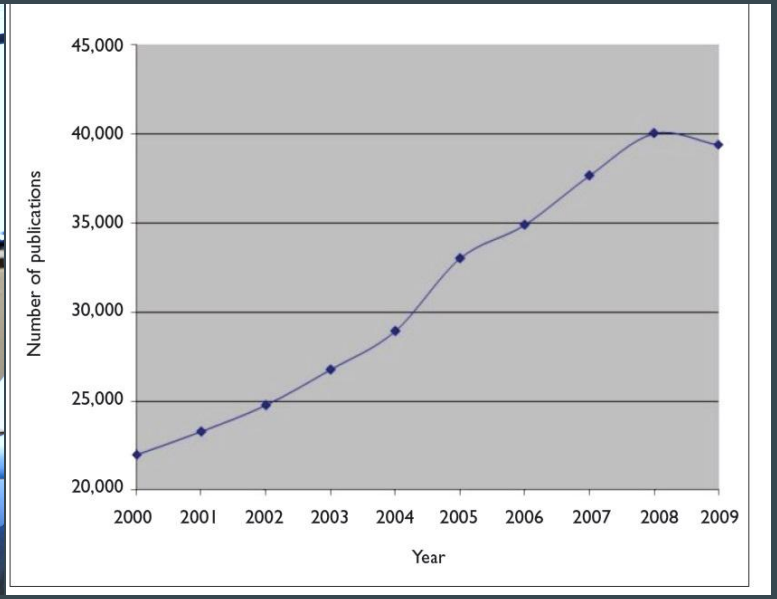
Perspectives: no biomarker is simply “good” or “bad”

Evolutionary Life History

Relative investment in different processes given finite energy, varying by life stage

E.g. allocate energy to growth/maintenance instead of reproduction

Not necessarily pathology, just adaptive strategy

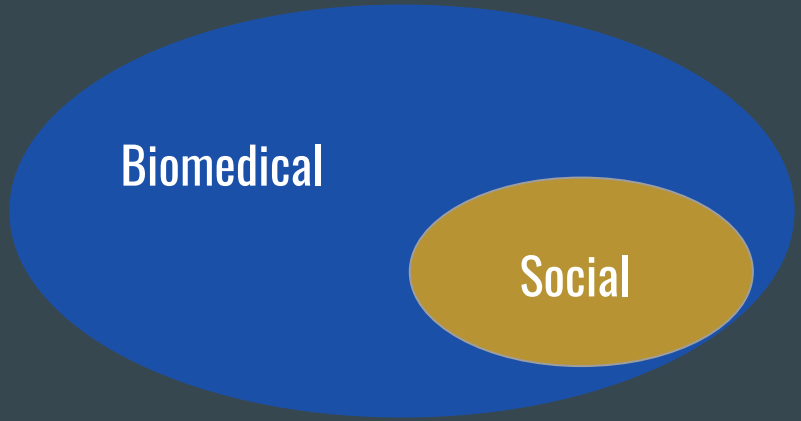


PubMed citations referencing “biomarker” as a keyword
2000-2009

Development and use of biomarkers is on the rise...

Because biomarkers are important windows to physiological processes & how our environments “get under the skin.”

Growing synergy of biomedical & life sciences with social science



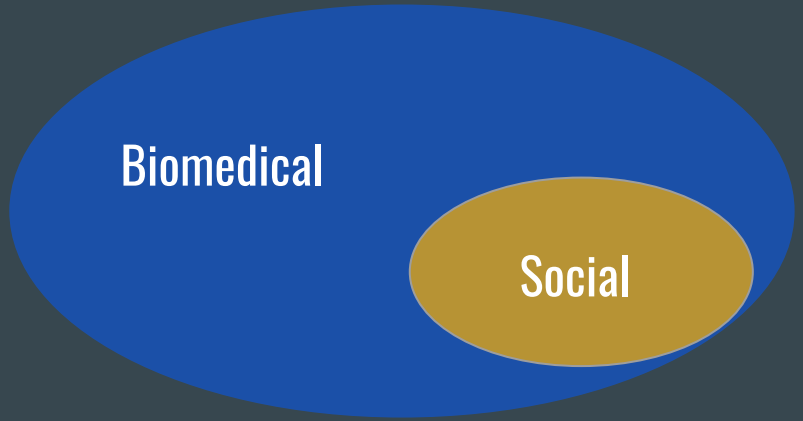
THE LANCET
Volume 365, Issue 9464, 19–25 March 2005, Pages 1099-1104

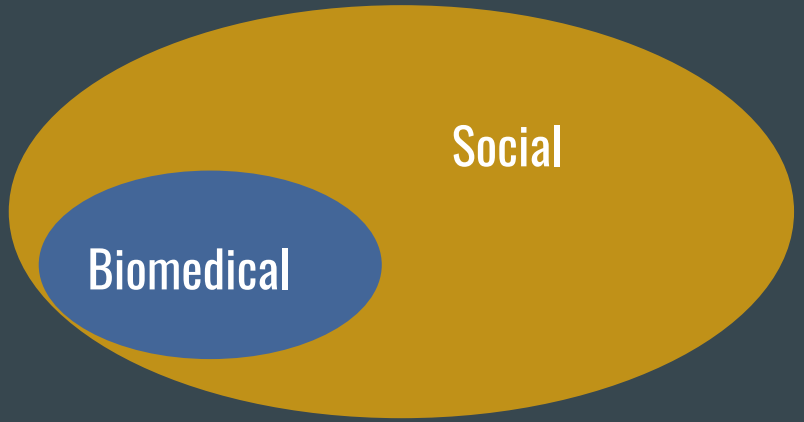
Public Health

Social determinants of health inequalities

Prof Michael Marmot [a] ✉

Growing synergy of biomedical & life sciences with social science





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SOCIOLOGY OF HEALTH & ILLNESS

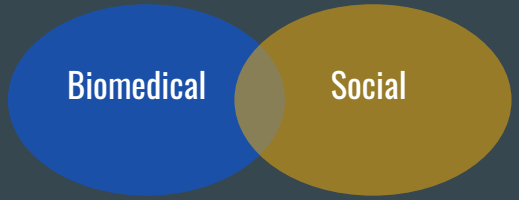
ORIGINAL ARTICLE

Messengers of stress: Towards a cortisol sociology

Celia Roberts ✉, Brigit McWade,

First published: 31 May 2021 | https://doi.org/10.1111/1467-9566.13261

Myriad long-term studies



NHANES

Whitehall Study

MacArthur Study of Successful Aging

National Longitudinal Study of Adolescent Health

Atherosclerosis Risk in Communities Study (ARIC)

Reasons for Geographic and Racial Differences in Stroke (REGARDS)

Coronary Artery Risk Development in Young Adults (CARDIA)

Women's Health Initiative

Framingham Heart Study

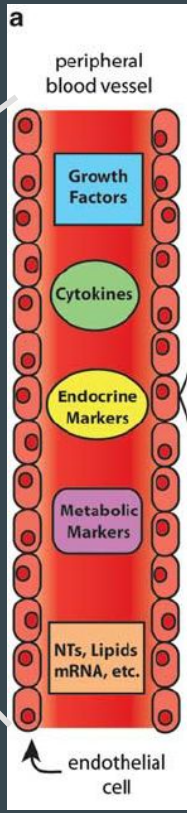
Multiethnic Study of Atherosclerosis

Midlife in the United States (MIDUS)

Tsimane Health and Life History Project

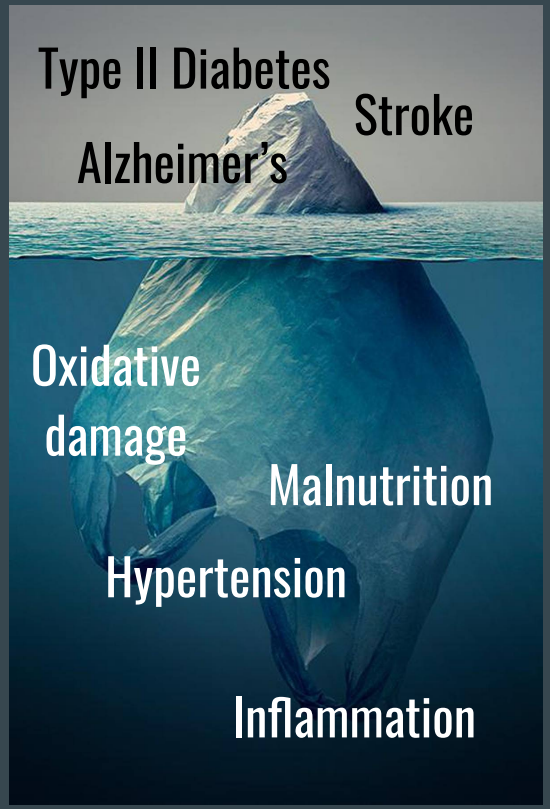
...

Biomarker literacy increasingly valuable to social scientists



Peripheral Biomarker Panel of MDD	
Growth Factors:	
	BDNF
	IGF-1
	VEGF
	GDNF
	FGF-2
	NT-3
	NGF
	VGF
	Growth Hormone
Cytokines & Markers of Inflammation:	
	IL-1β
	IL-1 receptor antagonist
	IL-6
	TNF-α
	IL-2
	IL-2 receptor
	IFN-α
	IFN-γ
	IL-8
	IL-10
	hs-CRP
Endocrine Markers:	
	Cortisol
	CRF
	ACTH
	Thyroid-Stimulating Hormone
	Thyroid Hormone (T3)
	17-β-estradiol
Metabolic Markers:	
	Insulin
	Blood Sugar
	Leptin
	Ghrelin
Other Markers:	
	Neurotransmitters
	Lipid Profiles
	Free Radicals
	mRNA transcripts

Biomarkers help identify subclinical signs of disease



Determine high risk individuals *before* major sickness

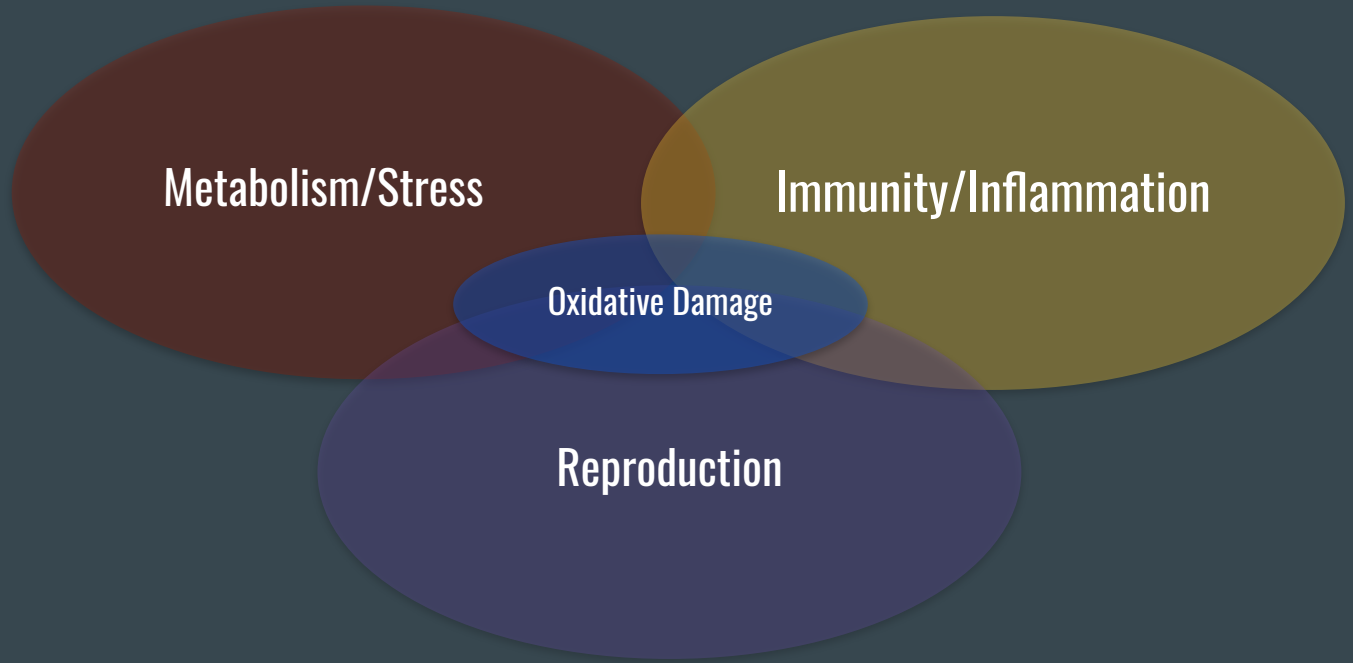
Target social and medical interventions

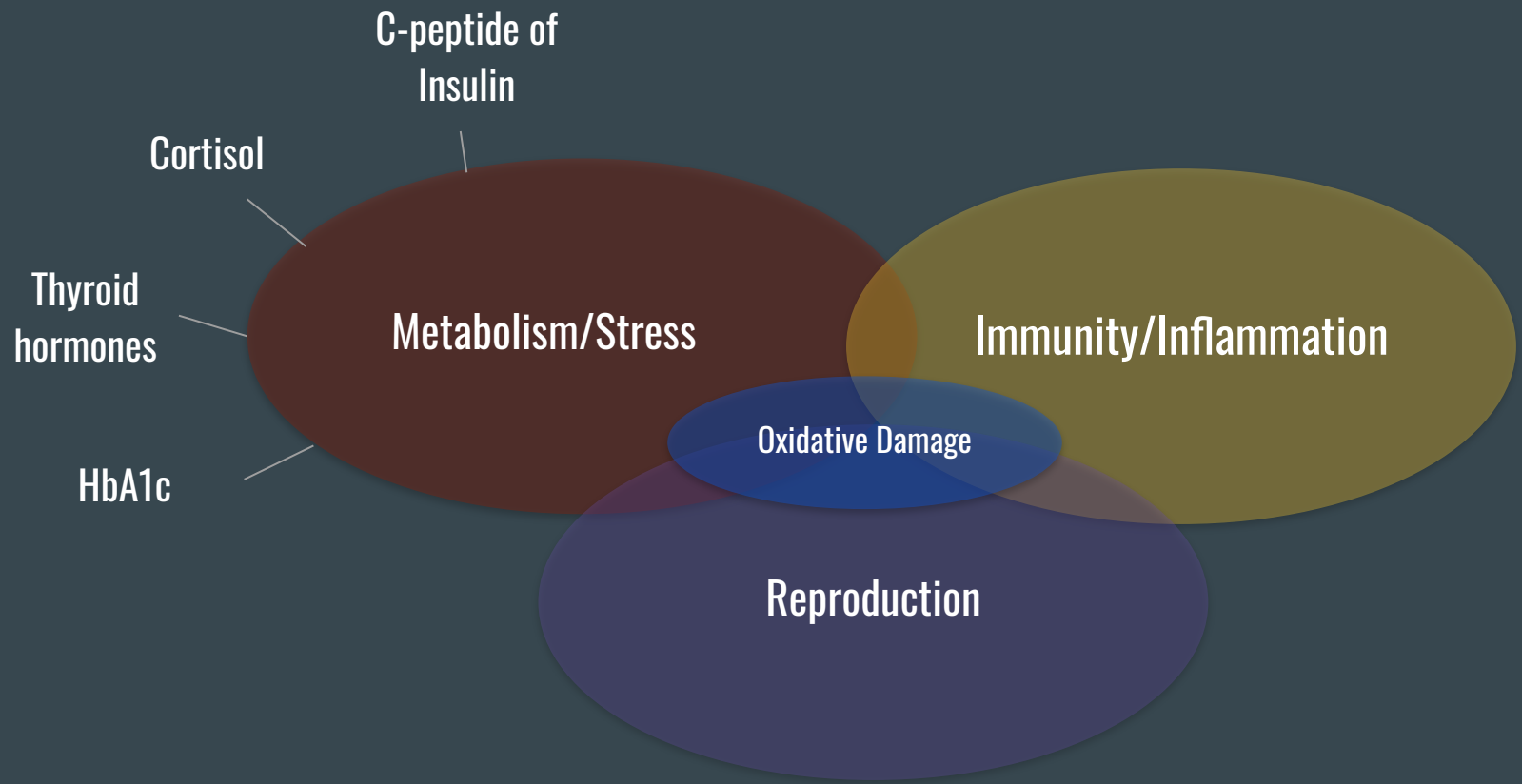
Reveal environmental & lifestyle risk factors of morbidity and mortality

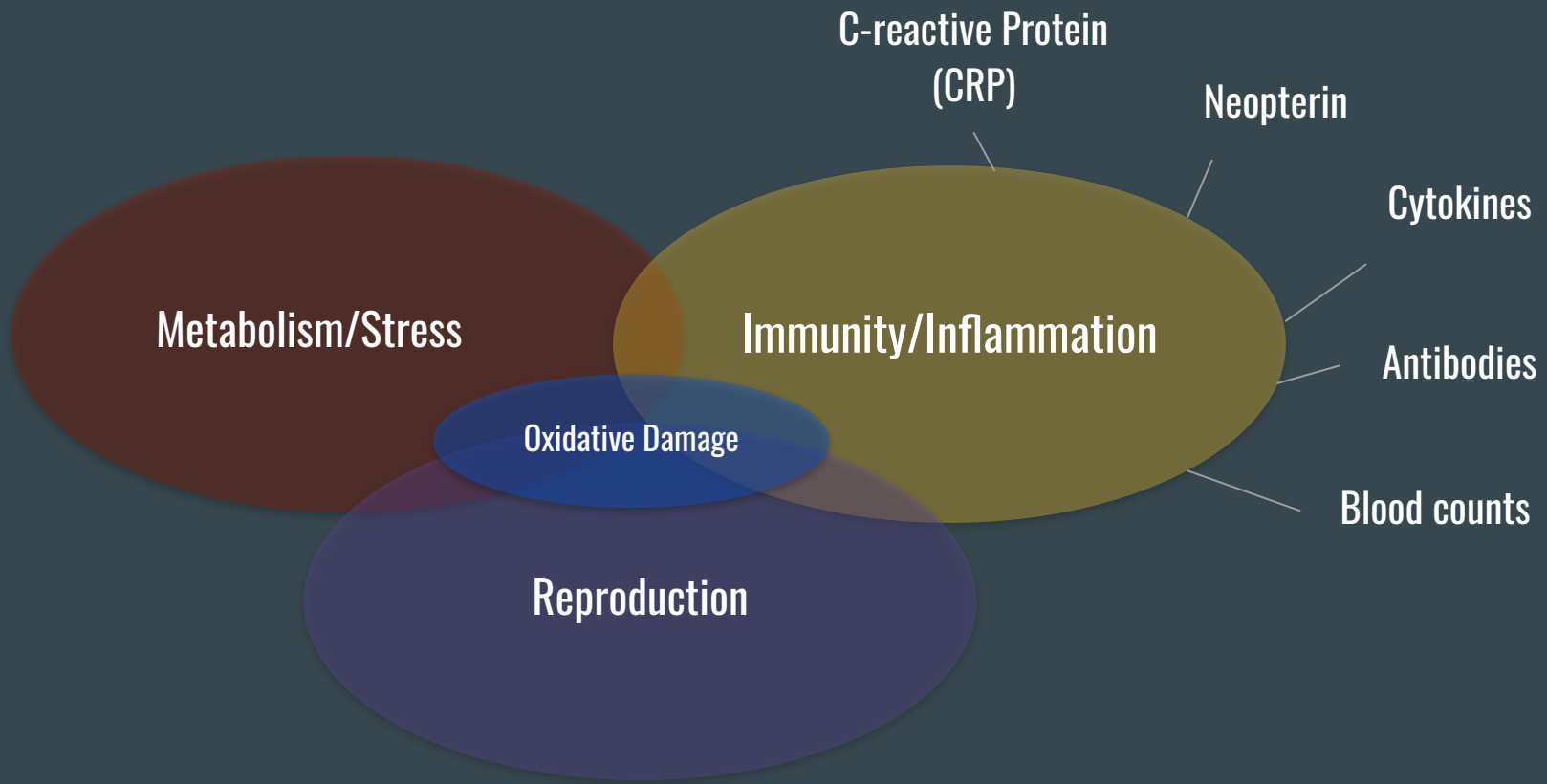
Field-friendly techniques with broader impacts to communities

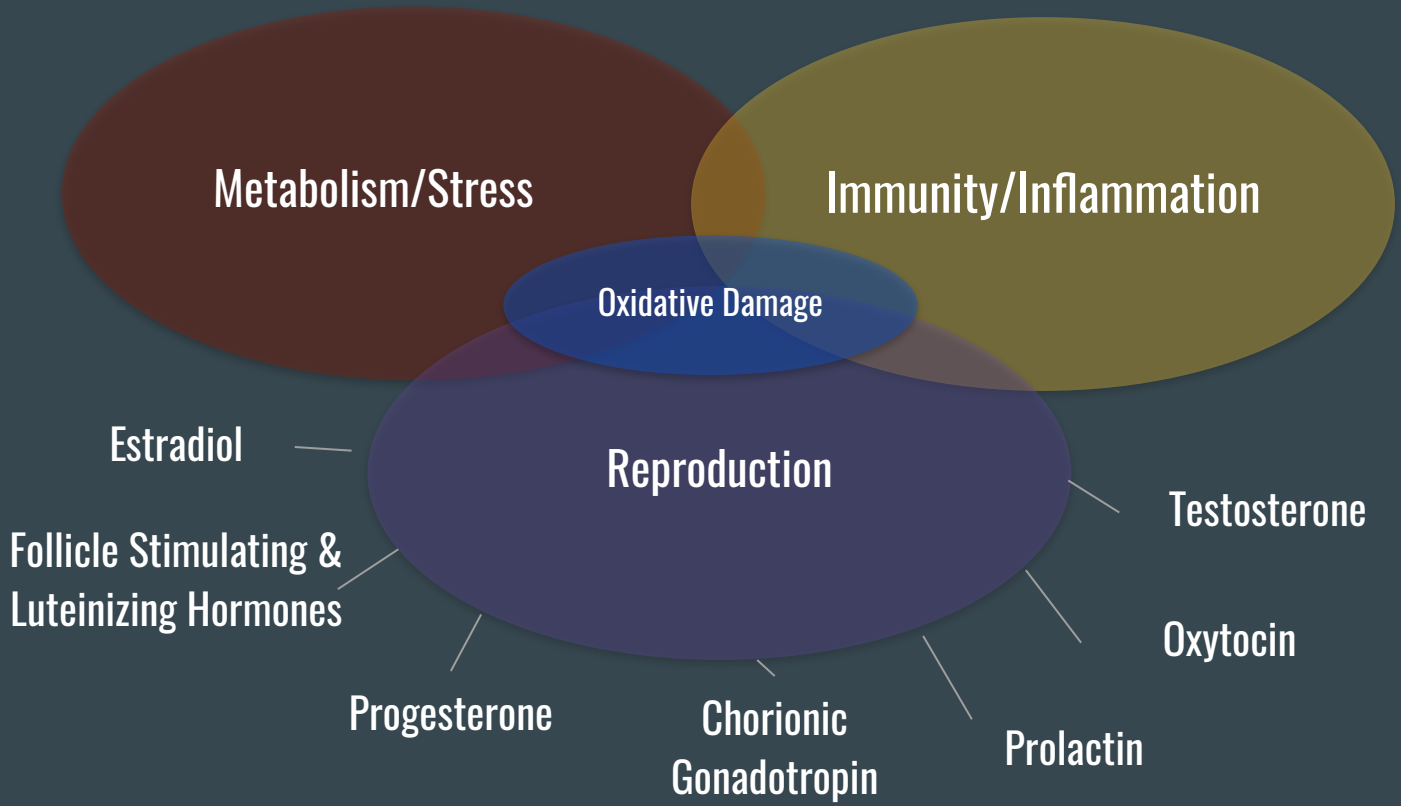
Photos: Mike Gurven

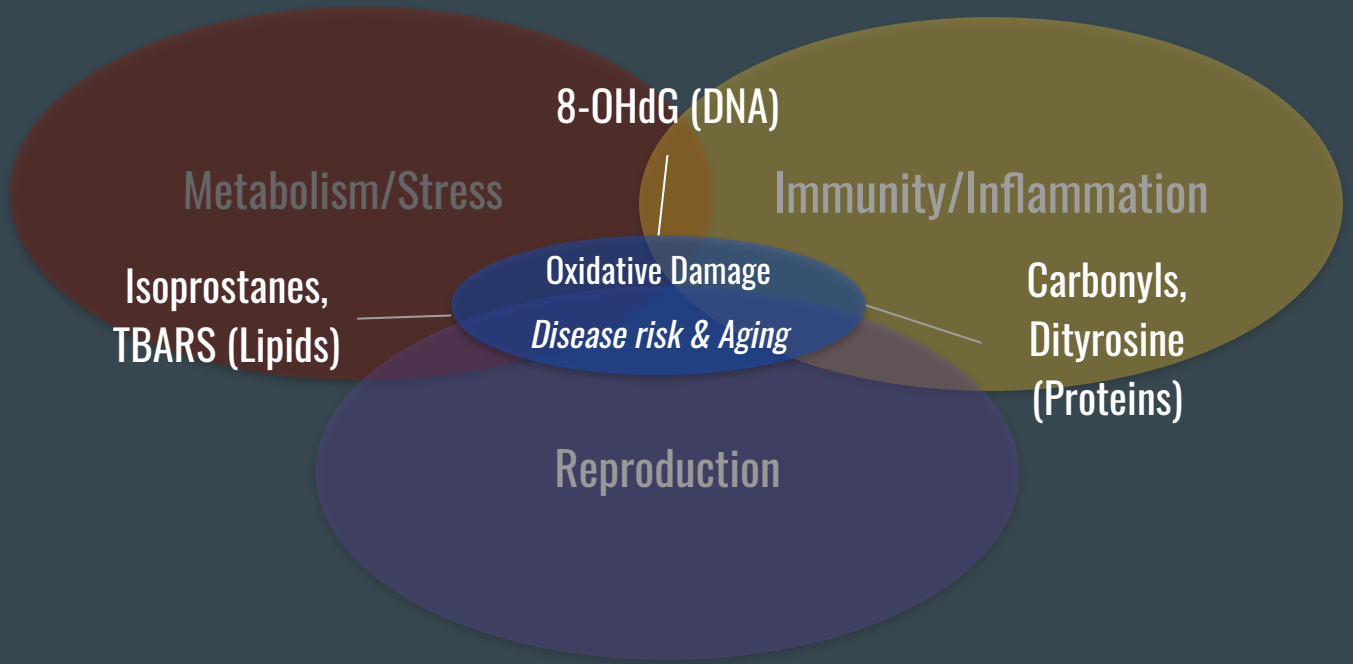
What do biomarkers measure?




C-peptide of Insulin
Cortisol
Thyroid hormones
HbA1c
Metabolism/Stress
Immunity/Inflammation
Oxidative Damage
Reproduction


C-reactive Protein (CRP)
Neopterin
Cytokines
Antibodies
Blood counts
Metabolism/Stress
Immunity/Inflammation
Oxidative Damage
Reproduction


Metabolism/Stress
Immunity/Inflammation
Oxidative Damage
Reproduction
Estradiol
Follicle Stimulating &
Luteinizing Hormones
Progesterone
Chorionic
Gonadotropin
Prolactin
Oxytocin
Testosterone


8-OHdG (DNA)
Metabolism/Stress
Immunity/Inflammation
Isoprostanes,
TBARS (Lipids)
Oxidative Damage
Disease risk & Aging
Carbonyls,
Dityrosine
(Proteins)
Reproduction

Where do we get biomarkers? 💦

Where do we get biomarkers? 💦

Cortisol, Estradiol, Testosterone, Oxytocin, Cytokines

Damn near everything: metabolic, immune, reproductive, oxi-damage

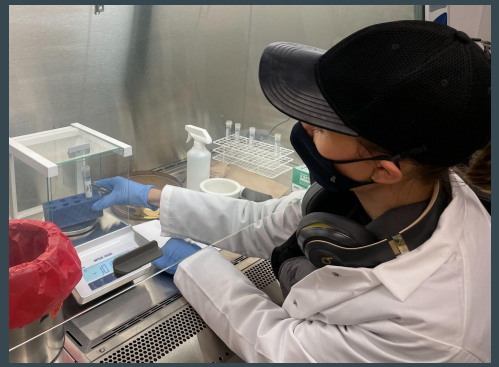
Most metabolic & reproductive hormones, Oxidative damage

Metabolites of metabolic & reproductive hormones, mucosal immunity

Biobehavioral Health Lab: where we'll train and learn

Biological research is for everyone

My pleasure to be with you at the start of your journey... should you choose it...



The Biobehavioral Health Lab at UCSB

- Specialize in radio- and enzyme- immunoassays for biochemical agents
  - Cortisol
  - Energy balance
  - Inflammation and immune activity
  - Reproductive hormones
  - Oxidative damage