Today’s Outline

• Why
• How
• What
Focus of Demographic Health Research: Differences and Trends in Health Outcomes

Demographic Factors
- Age
- Gender
- Ethnicity
- Race/Nativity

SES
- Education
- Income
- Wealth
- Poverty
- Occupation

Health Outcomes
- Mortality (by cause)
- Physical functioning
- Cognitive functioning
- Diseases
Mediating Mechanisms Explaining Differentials and Trends

Demographic Factors
- Age
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- Ethnicity
- Race/Nativity
- Language

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- Education
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Health Behaviors
- Exercise
- Drinking
- Diet
- Smoking
- Social Psychological
- Social support
- Marital status
- Depression
- Health Care Access
- Access to care
- Insur Coverage
- Medication usage

Health Outcomes
- Mortality (by cause)
- Physical functioning
- Cognitive function
- Diseases
Biological Risk or Paths

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- Medication usage

Biological Risk
- Cardiovascular Factors
- Lung Function
- Metabolic Factors
- Inflammation Markers
- HPA Function
- SNS Activity
- Renal Function
- Nutritional Status

Health Outcomes
- Mortality (by cause)
- Physical functioning
- Cognitive function
- Diseases
Uses of Biological Data

• Provide information about the biological mechanisms or paths
• Provide information about earlier processes than disease or death
• Provide information respondent does not know
• Use same scale for everyone
National Samples

• National sample – diversity, large numbers in subgroups
• We can compare the risk associated with a variety of biological, social and economic factors at the same time
• We do not expect to discover new biological relationships or risks for health outcomes (but we could find an interaction)
What is measured
- is related to both why and how

• Risk factors known to be related to major health outcomes – high in prevalence
• Indicators of physiological states with significant influence on those outcomes
• What can be done under study/survey circumstances
Initial Operationalization of Allostatic Load - MacArthur

- Cardiovascular
- HPA Axis
- Symp. Nerv. Sys
- Metabolism

- Resting Systolic, Diastolic BP
- Ur. cortisol (12 hr), DHEA-S
- Ur. Norepinephrine, epinephrine (12hr)
- Gly. Hemoglobin, HDL/total Cholesterol, WHR

MacArthur - a few sites, in-home collection by phlebotomist, of urine 12 hour, blood
Cumulative Biological Risk: “allostatic load”

Life Experiences (Protective & Damaging)*

↓

Biological “Aging”

↓

Morbidity, Functioning, Mortality

*Contextual effects - sex, ethnicity, socio-economic status?
Adaptive Allostasis vs. Allostatic “wear & tear”

System Parameter (e.g., BP, Glucose, Cortisol)

Allostatic Load

(Stimulus)

TIME

Adaptive allostasis
Biological Risk Components

- **Cardiovascular Factors**
  - Systolic Blood Pressure
  - Diastolic Blood Pressure
  - Pulse
  - Response to Exercise

- **Metabolic Factors**
  - HDL Cholesterol
  - Total Cholesterol
  - Glycated Hemoglobin
  - BMI / waist-hip ratio /waist
  - Triglycerides
  - Plasma Glucose
  - Uric Acid

- **Vitamin/Antioxidant status**
  - Homocysteine/Folic Acid
  - Vitamins, Beta Carotene

- **Sympathetic Nervous System**
  - Epinephrine
  - Norepinephrine

- **Hypothalamic Pituitary Axis**
  - Urinary Cortisol
  - DHEA-S

- **Inflammation Markers**
  - Serum Albumin
  - CRP
  - Fibrinogen
  - IL-6

- **Genetic Differences**

Lung Function – Peak Flow

Renal Function - Creatinine Clearance
Health Consequences of Biological Risk

- Blood Pressure
  - CHD / Stroke / Cog. & Phys Impairments

- Metabolic Syndrome
  - Glucose: CHD/Cognitive/Physical & Vision Impairments
  - Lipids: CHD/ Cognitive
Health Consequences (cont’d)

• Inflammation
  – CHD/Cog & Phys Functioning/Mortality

• HPA Axis
  – Cog. impairment/Depression/CHD/
  – Immune Dysfunction

• SNS
  – CHD/Hypertension/Mortality
National Data

National Health and Nutrition Examination Surveys (NHANES) – NCHS
Health and Retirement Survey (HRS) – David Weir, Mary Beth Ofstadhal
National Social Life Health and Aging Project (NSHAP) – Linda Waite, Stacy Lindau and Thom McDade
English Longitudinal Study of Aging (ELSA) – James Banks
Mexican Family Life Survey (MxFLS) – Duncan Thomas, Elizabeth Frankenberg, Luis N. Rubalcava and Graciela Teruel
Indonesian Family Life Study (IFLS) – John Strauss
Mexican Health and Aging Study (MHAS) – Beth Soldo and Alberto Palloni
NHANES
NHANES

• Cross sectional – except for passive followup of death, Medicare
• (NHANES 1 – actively followed)
• Collection done with trucks and many medical personnel for whole day
• Extensive measurement
• Half sample is fasted overnight
NHANES Mobile Examination Center
Biomarkers in NHANES

- Hematology
- General Biochemistry Tests
- Antibody Tests
- Biochemistry Profile
- Diabetes Testing Profile
- Urine Tests
- Eye, Audiometry
- Blood Pressure, Chest, Heart
- Body Measures
- Periodontal Assessments
- Physical Functioning,
- Balance
- CV Fitness
- Cognitive Test, Reaction
- STDs
Biomarkers in NHANES III

**Laboratory**
- Hematology
- General Biochemistry Tests
- Antibody Tests
- Biochemistry Profile
- Diabetes Testing Profile
- Urine Tests

**Exam**
- Eye, Audiometry
- Blood Pressure, Chest, Heart
- Dermatitis
- Lower Extremities Joint Exam
- Breast Size and Tanner Staging
- Body Measures
- Periodontal Assessments
- Allergy Skin Test
- Cognitive Test, Reaction
- Physical Functioning
Biomarkers in NHANES 1999-2004

**Laboratory**
- *Immunogenic*: CRP, Creatinine, Complete Blood Count, Methicillin-Resistant Staphylococcus Aureus, Erythrocyte Protoporphyrin, Hepatitis, Measles/Rubella/Varicella, Hematology, Phlebotomy, PSA

**Laboratory**
- *STDs*: HIV, Chlamydia/Gonorrhea, Herpes I & II, Syphilis/Treponema Pallidum, Trichomoniasis/Vaginalis/Bacterial Vaginosis
- *Toxicology*: PHPYPA Urinary Phthalates, Pesticides, Dioxins, Heavy Metals, Toxoplamsa, Lead Dust

**Exam**
- Audiometry, Vision
- Body Measurements
- Blood Pressure, CV Fitness
- Dietary
- Physical Functioning, Balance
- Oral Health
HRS
Reasons For and Against Adding Biomarkers

• Against
  – Ongoing survey with valuable longitudinal data and people might not want to be asked for something new and they will drop out of the entire survey
  – People will be overburdened as the interview is already very long
  – It will cost a lot of money

• For
  – Scientific reasons
  – ELSA did it
  – Technology available
  – Subsamples for ADAMS and Diabetes studies were successful
HRS 2006 – Face to Face Interview - Interviewer (1//2 sample) – No fasting

- Measured height, weight, and waist
- Blood pressure
- Performance measures – timed walk, grip strength, puff test, balance test
- Salivary DNA for repository
- Dried Blood Spots – Glycosylated hemoglobin, total cholesterol and HDL, C-reactive protein +
Technology

• DNA – Saliva (HRS - Scope Mouthwash), buccal swabs (used in ADAMS and Denmark), blood

• Dried Blood Spots (HRS - DBS) – Thom McDade

• Meters – Glucometer, hemocue
Saliva Collection Device

Lancet for cutting finger for DBS
Cutting Punches from Guthrie Dried Blood Spot Card

Figure 1. Cutting punches from a Guthrie card

Issues

• Labs – Assay values will vary
  – Need documentation to make comparisons across assays
• Assays – Many are not done by hospital labs regularly (hsCRP – IL-6)
• Instrumentation – Blood pressure can be taken by a person or a machine
HRS Preliminary Results – 2006 Interview

- Slides on participation prepared by Mary Beth Ofstadhal
- Slides on results prepared by David Weir
- Presented June 5th at the Co P.I. meeting
- Do not cite these results without permission of Ofstadhal or Weir
Informed Consent

- Booklet is 12 pages
- Each set of tests has its own consent and tests are done before moving to next consent
- Physical Performance – measurement of blood pressure, ht/weight/waist, puff test, walk, balance, grip strength
- Saliva – for DNA
- Blood spots
- Permission in two stages – known tests, stored for future use
HRS - Dried Blood Spots

- HRS – Still in process –
- CRP
- Others available from one spot at the same time? Serum Amyloid A, cystatin-C, Epstein-Barr or CMV
ELSA

- Nurse – every other visit – 4 years
- Blood pressure, lung function, anthropometric measures (height, weight, waist, hip)
- Blood - haemoglobin and ferritin, inflammatory markers of C-reactive protein and fibrinogen, lipids, fasting lipids, fasting glucose, and glycated haemoglobin.
- Physical functioning was assessed using balance tests, timed chair stands, and grip strength
- Cortisol from saliva samples taken over one day and accompanied by a diary
- Extraction of DNA for a genetic repository.
NSHAP Biomakers

- Physical measures: Height, Weight, Blood pressure, Pulse
- Sensory function: Smell, Touch, Taste, Vision
- Get up and go
- Assays collected: Bacterial vaginosis, Vaginal cell cytology, HPV, Yeast vaginosis, Cotinine, DHEA, Estradiol, HIV, Progesterone, Testosterone, CRP, EBV
- Glycosylated hemoglobin (HbA1c)
- Hemoglobin
ADDHEALTH

- Height
- Weight
- Chlamydia
- Gonorrhea
- Trichomoniasis
- HPV
• **MxFLS** 2002 - anthropometry, hemoglobin levels (meter) and blood pressure - 2005 – blood spots
• **IFLS** – blood pressure, anthropometry, dried blood spots (2007)
• **MHAS** – Blood pressure, anthropometry, performance measures
New Measurement (??)

- **TILDA - Magic Carpet** to measure balance
- **David Wong** – Future RNA with saliva (genetic) markers that are indicators of disease
- **Arthur Stone** – Monitors of daily activity level
- **Telephone monitoring of cardiovascular risk factors**
Magic Carpet
Portable Sonogram
Portable ECG
Ecological Momentary Assessment (EMA)

- Signals participants to report on current psychological, behavioral and environmental states
- Signaling through a small electronic device (e.g. paging devices, palmtop computers, programmable wristwatches)
- Reduces biases related to retrospective recall
Future Directions: New Biological Parameters

• Metabonomics - metabolic profiles
• Proteomics
Genes

• Modulations of genotype risks
  – By demographic characteristics, social factors, behaviors (e.g., exercise, smoking)
  – other genetic and biologic social factors

• DNA expression, damage
  – (telomere length, mitochondrial damage) –
APoE, Antioxidants & Cognitive Decline: effects of low serum beta-carotene

Odds of Cog. Decline for Low vs. High Antioxidant Levels


“Adj demos” model = 1988 SPMSQ, age, sex, race, ed, income,

“Adj all = demos + smoking. Alcohol, CRP, IL-6, total & HDL cholesterol, BMI
Future Directions - New Population data

• Cross national studies of populations at different levels of socioeconomic development and different disease environments to clarify the relative role of different types of biological risk under different circumstances

• Studies across the age range to clarify the effects over the lifespan of biological risk
The End
Summary Measures of Allostatic Load

• Original Equi-weighted (for each of 10 parameters)
  – Identify scores in top quartile of risk
  – Count number of parameters for which subject has a score in top quartile.

Range of Scores
(0-10)

• Cannonical Correlation based scoring
  – For each parameter:
    • Use raw scores (i.e., full range of scores)
    • Weight by cannonical weight

Range of Scores
(5.2-10.4)
Original AL score vs. Canonical score - Correlations with 7-yr change in function

![Bar chart comparing Original AL score vs. Canonical score for 7-yr change in function](chart.png)

- **Physical Fx**
  - Canonical: 0.40
  - Equi-Wt'd AL: 0.35

- **Cog. Fx**
  - Canonical: 0.20
  - Equi-Wt'd AL: 0.15
APOE & Education

Educational Attainment ("no HS" = ref group)

<table>
<thead>
<tr>
<th>APOE4+</th>
<th>APOE4-</th>
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<tbody>
<tr>
<td>Some HS</td>
<td>0.4</td>
</tr>
<tr>
<td>HS</td>
<td>0.48</td>
</tr>
<tr>
<td>&gt;HS</td>
<td>1.1</td>
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APOE & Cognitive Decline [SPMSQ] (1988-'95)

Average Decline:
- APOE4+ (63% declined) -1.5
- APOE4- (52% declined) -0.8