Health psychology = behavioral medicine
- the role of behavior in promoting health and preventing and treating disease
- new areas of study in behavior genetics:
  stress $\rightarrow$ cardiovascular risk
  body weight $\rightarrow$ obesity
  additive behaviors smoking, alcoholism
Stress and cardiovascular risk

Cardiovascular disease leading cause of death in USA, in both males and females

- Individual reaction to stress may play a role in risk for cardiovascular disease
  - Large stress reaction associated with increase in cardiovascular disease

- Reactions to stress have been shown to have a genetic component:
  10 twin studies, varied age groups, mix of males and females, mixture of stressors (video games, reaction-time tests, color-word tests, mental math, speech tasks, mirror-drawing)
  - Stress reaction measured in terms of heart rate and blood pressure changes
  - Moderate gene influences: heritabilities HR 30-50% BP 60-70%
  - No shared environment

- Reactions to stress outside lab much more difficult to measure over long term
  - People chose how and where to live
  - Some avoid stress, some seek it out
  - Gene influence likely to be present at all levels of choice

Identifying contributing genes

Using methods to locate QTLs – +10 genes involved in blood pressure

One QTL involved in reactivity of blood pressure to stress:
alpha-1-antitrypsin gene - Product protects against inflammation
  - Smoking/emphysema risk also

Rare single-gene effect: familial hypercholesterolemia
### TABLE 2
Frequently Cited Randomized Trials of Behavioral Medicine Interventions in Cardiology

<table>
<thead>
<tr>
<th>NUMBER OF PATIENTS/TYPE OF DIABETES/REFERENCE</th>
<th>INTERVENTION</th>
<th>LENGTH OF FOLLOW-UP</th>
<th>OUTCOME MEASURE</th>
<th>FINDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>117 patients with mild essential hypertension92</td>
<td>12 sessions, 45 minutes twice weekly, of breathing-relaxation training and biofeedback</td>
<td>1 year</td>
<td>Patients whose systolic or diastolic blood pressure decreased by &gt;10% from baseline (%)</td>
<td>Treatment: 56%  Control: 32%3</td>
</tr>
<tr>
<td>48 patients with mixed coronary heart disease92</td>
<td>Lifestyle program of diet, exercise, stress management, smoking cessation, and group psychological support</td>
<td>3 years</td>
<td>Cardiac hospitalizations per patient</td>
<td>Treatment: 0.92  Control: 2.25</td>
</tr>
<tr>
<td>285 patients with myocardial infarction92</td>
<td>Scheduled interaction between case managers and patients after discharge; 14 nurses initiated telephone contacts; progress reports mailed to patients; and 4 individual nurse sessions of exercise testing, diet-drug therapy for hyperlipidemia, and smoking cessation</td>
<td>6 months after MI</td>
<td>Smokers who quit 2 months after MI (non-smoking status was biochemically confirmed) (%)</td>
<td>Treatment: 76%  Control: 53%5</td>
</tr>
<tr>
<td>52 patients with mixed coronary artery disease92</td>
<td>3 weekly groups of pain management and relaxation training, cognitive reframing, and problem solving</td>
<td>1 month</td>
<td>Weekly chest pain frequency (range 0 to &gt; 5 times/day)</td>
<td>Treatment: 1 less episode/week  Control: 0.5 more/week1</td>
</tr>
</tbody>
</table>

### TABLE 1
Frequently Cited Studies of Behavioral Medicine Interventions in Cancer Patients

<table>
<thead>
<tr>
<th>NUMBER OF PATIENTS/TYPE OF DIABETES/REFERENCE</th>
<th>INTERVENTION</th>
<th>LENGTH OF FOLLOW-UP</th>
<th>OUTCOME MEASURE</th>
<th>FINDING</th>
</tr>
</thead>
<tbody>
<tr>
<td>Randomized trials</td>
<td>Fifty-two 90-minute group sessions of coping, emotional expression, relaxation training, psychological support</td>
<td>10 years</td>
<td>Mean survival (50)</td>
<td>Treatment: 35.8 months (37.6)  Control: 18.9 months (10.8)</td>
</tr>
<tr>
<td>235 patients with metastatic breast cancer82</td>
<td>Fifty-two 90-minute group sessions of coping, emotional expression, relaxation training, psychological support</td>
<td>6 years</td>
<td>Mean survival (NS)</td>
<td>Treatment: 17.9 months  Control: 17.8 months</td>
</tr>
<tr>
<td>60 patients with metastatic breast cancer82</td>
<td>Six 90-minute group sessions consisting of health education, problem solving, stress management, and psychological support</td>
<td>6 months</td>
<td>Mean TMD score (SD)</td>
<td>Treatment: Baseline, 38.8 (39.8)  Change: 8.7 (24.6)  Control: Baseline, 37.6 (38.2)  Change: 5.8</td>
</tr>
<tr>
<td>Observational study</td>
<td>Three to five 30-minute individual hypnosis sessions before chemotherapy</td>
<td></td>
<td>Chemotherapy session</td>
<td>Anticipatory emesis</td>
</tr>
<tr>
<td>6 patients with mixed cancer diagnoses with anticipatory emesis82</td>
<td></td>
<td></td>
<td></td>
<td>Treatment: 100%  Control: 0%</td>
</tr>
</tbody>
</table>

*Derived from Profile of Mood States, Total Mood Disturbance (TMD) scores range from 0 to 212; higher scores = lower mood.
Although there are no norms for the TMD score, the reduction in overall scores with an increase in treatment was probably a clinical reduction in overall distress, with no such improvement noted for the control group.

1P < 0.01
2P < 0.05
Eating disorders

• severe disturbances in eating behavior

anorexia nervosa (AN)  extreme dieting, avoidance of food,
   fear of weight gain, extremely low body weight
   females : highest mortality among psychiatric disorders

bulimia nervosa (BN)  binge eating followed by vomiting /
   purging, not necessarily accompanied by low weight
Onset:  late adolescence, early adulthood, mostly females
Prevalence:  AN  1 – 2% females  0.1 – 0.2% males

- familial, frequently comorbid with mood and anxiety disorders
  AN and MDE  genetic correlation = 0.58
  34% of genetic variance is common between AN, MDE

First twin study 1991  anorexia
  Concordances:  MZ = 59%
  DZ = 8%
  - clear genetic influence  heritability ~ 58%  e² = 42%

First studies on bulimia indicated no gene influence
  MZ = DZ concordance  ~37%
Recent studies show bulimia has been diagnosed with very
   low reliability  (kappa = 0.28)

- with more reliable measures, recent family and twin studies
  indicate stronger genetic influence

- several candidates genes found for both disorders
Body weight and obesity

• animal studies indicate genetic component for tendency towards certain body mass
  can selectively breed for fat mass/ muscle mass

Health problems caused by high body weight/obesity

“..obesity is probably the second leading preventable cause of death in the US .”
  Manson, 1999

High body mass
- increases risk for Type II diabetes, heart disease and cancer
  1/3 of cancer deaths are related to diet and inactivity (American Cancer Society)
- contributes more to health-care costs than either smoking or problem drinking
- reaching obesity has same effect on chronic health conditions as aging from 30 to 50

Sturm (2000)  financial burden of obesity

Survey of 10,000 households, 1997-98 , 18 - 65 year-olds
- all effects compared with non-drinking, non-smoking, healthy weight members

obesity:
  36% increase in hospital/outpatient spending
  77% increase in medication costs

smoking:
  21% increase in health services
  28% increase in medication costs

problem drinking:
  10% increase in health services
  decrease in medication costs
Science  ‘Special issue’ on Obesity  Feb, 2003

• identified obesity as ..” the great public health irony of the 21st Century
  - hundreds of millions of people across the world lack adequate food and suffer
deficiency diseases
  - hundreds of millions in other parts of the world overeat to the point of
increasing their risk of diet-related chronic diseases

• problems associated with obesity divert scarce resources away from
food security in poorer countries to take care of people with preventable
heart disease and diabetes

• food is overproduced in richer nations
  - USA food supply provides 3800 kcals/person/day
  = 2 times that required by most adults, given their lifestyles

• supplying food is ‘big business’ in richer nations
  - large adjustments to the US economy would have to be made if people ate
more healthily

Prevalence of overweight and obesity

Worldwide  +1 billion adults are overweight
  300 million are clinically obese

UK  obesity rate has tripled in 20 years
  2/3 of adults are overweight

USA  20 states have obesity rate of 15 - 19%
  29 states have obesity rate of 20 - 24%
  1 state has rate of +25%

France  obesity rate if 8%  but rising
Measurement of body mass

- body mass index (BMI)
  \[ \text{BMI} = \frac{\text{weight in kg}}{\text{height in m}^2} \]

- weight in lbs: \[ \text{wt(lbs)} \times 703 \]
- height in inches: \[ \text{ht(ins)}^2 \]

<table>
<thead>
<tr>
<th>BMI</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>10 -12</td>
<td>Dead</td>
</tr>
<tr>
<td>16.7</td>
<td>Kate Moss</td>
</tr>
<tr>
<td>26.5</td>
<td>mean, US adults</td>
</tr>
<tr>
<td>25</td>
<td>‘overweight’ US government guidelines</td>
</tr>
<tr>
<td>~28</td>
<td>morbidity increases</td>
</tr>
<tr>
<td>30</td>
<td>obese</td>
</tr>
<tr>
<td>40</td>
<td>‘morbidly obese’</td>
</tr>
<tr>
<td>43.7</td>
<td>average sumo wrestler</td>
</tr>
<tr>
<td>45</td>
<td>Chris Farley when he died</td>
</tr>
</tbody>
</table>

Food intake

- based on self-reports, the obese do not eat more than people with healthier weights:
  - correlation between self-reported food intake and obesity = -0.16
- when food intake is actually measured
  - correlation = 0.56

Twin correlations for food intake: MZ > DZ
  - indication of genetic influence

- several genes influencing appetite have been located
Family, twin and adoption studies on body weight

• indicate genetic influence on body weight

<table>
<thead>
<tr>
<th>Relationship</th>
<th>Correlations for body weight</th>
</tr>
</thead>
<tbody>
<tr>
<td>MZ</td>
<td>0.82 reared apart = 0.72</td>
</tr>
<tr>
<td>DZ</td>
<td>0.43</td>
</tr>
<tr>
<td>Siblings</td>
<td>0.34</td>
</tr>
<tr>
<td>Adoptive sibs (non-bio)</td>
<td>0.01</td>
</tr>
<tr>
<td>Parent/offspring</td>
<td>0.26</td>
</tr>
<tr>
<td>Parent/adopted-away offspring</td>
<td>0.23</td>
</tr>
<tr>
<td>Adoptive Parent/offspring</td>
<td>0.00</td>
</tr>
<tr>
<td>Spouses</td>
<td>0.13</td>
</tr>
</tbody>
</table>

• very little shared environment
• heritability ~ 70% additive genes
• non-shared environment

similar results for BMI and skin-fold thickness

• most variation for body mass seems to come from genes not the environment
• to maintain a healthy body weight, each person will have to be eating/exercising to different extents depending on their genetic tendencies

Gene influence could act at all possible levels, including interacting with the environment:

- BMR - internal, physiological controls
- appetite control - hormonal / brain interaction
- tendency to be active / exercise
- personality - will-power to change, attitudes to what constitutes overweight / obesity
- attitudes to eating
Developmental aspects

longitudinal twin studies:

Correlations at birth: MZ = DZ = 0.6 – 0.7 h² = 0
at 1 year: MZ = 0.87
DZ = 0.58 h² = 60%

• birthweight is NOT a good indicator of future weight
• no genetic variation for birthweight indicated
• best predictor of future weight is rapid growth of body fat around age 6
  – earlier spurt is correlated with obesity in adulthood

most genes contribute to continuity – lifestyle changes to maintain healthy weight also have to be continuous

Identifying genes for obesity

• ‘obese’ gene in mice 1950’s recessive allele → obesity
gene cloned in 1994
• product identified as leptin
  - a hormone that decreases appetite and increases energy use in mice → thin mouse
• leptin receptor gene active in mouse brain
• same hormone found in humans, gene for leptin chr 2
  - little/no variation for it is found
  - leptin receptor now being studied
• several genes influencing levels of leptin now being investigated
• many other genes found to have influence, replication of studies needed