Affect and Energy Balance: Implications for Diet & PA across the Cancer Continuum

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\textsuperscript{2}Basic Biobehavioral & Psychological Sciences
What is Energy Balance?
Winning Losing Strategies

Exercise at least three times a week (73%)
Increase physical activity in daily routines, e.g., using stairs instead of elevator (40%)
Reduce the amount of food eaten per meal (57%)
Eat fewer fatty foods (79%)
Eat fewer sweets and junk food (75%)
Eat more fruits and vegetables (72%)
Cut out snacking between meals (52%)
Drink fewer alcoholic beverages (99%)
Eat reduced-calorie or reduced-fat products (65%)
Eat smaller, more frequent meals 0.6%)

Primary Components of Energy Expenditure

Why (Energy Balance) Behaviors are Important
<table>
<thead>
<tr>
<th>Cause</th>
<th>Number</th>
<th>Percentage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Tobacco</td>
<td>435,000</td>
<td>18%</td>
</tr>
<tr>
<td>Diet &amp; Activity</td>
<td>400,000</td>
<td>17%</td>
</tr>
<tr>
<td>Alcohol</td>
<td>85,000</td>
<td>4%</td>
</tr>
<tr>
<td>Microbial agents</td>
<td>75,000</td>
<td>3%</td>
</tr>
<tr>
<td>Toxic agents</td>
<td>55,000</td>
<td>2%</td>
</tr>
<tr>
<td>Motor Vehicle Crash</td>
<td>43,000</td>
<td>2%</td>
</tr>
<tr>
<td>Firearms</td>
<td>29,000</td>
<td>1%</td>
</tr>
<tr>
<td>Sexual Behavior</td>
<td>20,000</td>
<td>1%</td>
</tr>
</tbody>
</table>

From: Mokdad et al, *JAMA*, 2004
Cancer Control Continuum: The Role of Energy Balance

Prevention | Detection | Treatment | Treatment | Recovery, Rehabilitation | Disease Prevention, Health Promotion | Palliation | Survival
---|---|---|---|---|---|---|---
Prescreening | Screening | Pretreatment | Treatment | Survivorship | End of Life

PRE DIAGNOSIS | POST DIAGNOSIS
---|---
Physical Activity | Physical Activity | Physical Activity
Diet | Diet | Diet

Adapted from Courneya & Friedenreich, 2007
Affect and Energy Balance Behaviors: Feedback

Diet
Physical Activity

Affect
Emotion
Energy Balance and Affect: Dietary Intake
# Obesity and Cancer Risk

## Body Fatness, and the Risk of Cancer

In the judgement of the Panel, the factors listed below modify the risk of cancer. Judgements are graded according to the strength of the evidence.

<table>
<thead>
<tr>
<th></th>
<th>Decreases Risk</th>
<th>Increases Risk</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Exposure</strong></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Convincing</td>
<td>Body fatness</td>
<td>Oesophagus¹</td>
</tr>
<tr>
<td></td>
<td>Abdominal fatness</td>
<td>Pancreas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Colorrectum</td>
</tr>
<tr>
<td>Probable</td>
<td>Body fatness</td>
<td>Breast (postmenopause)</td>
</tr>
<tr>
<td></td>
<td>Breast (premenopause)</td>
<td>Endometrium</td>
</tr>
<tr>
<td></td>
<td>Abdominal fatness</td>
<td>Kidney</td>
</tr>
<tr>
<td></td>
<td>Adult weight gain</td>
<td>Colorectum</td>
</tr>
<tr>
<td>Limited — suggestive</td>
<td>Body fatness</td>
<td>Gallbladder²</td>
</tr>
<tr>
<td></td>
<td>Low body fatness</td>
<td>Pancreas</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breast (premenopause)</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Endometrium</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Breast (postmenopause)</td>
</tr>
<tr>
<td>Substantial effect on risk unlikely</td>
<td>None identified</td>
<td>Liver</td>
</tr>
<tr>
<td></td>
<td></td>
<td>Lung</td>
</tr>
</tbody>
</table>

¹ For oesophageal adenocarcinomas only.
² Directly and indirectly, through the formation of gallstones.

For an explanation of all the terms used in the matrix, please see chapter 3.5.1, the text of this section, and the glossary.
Relationship Between Metabolic and Hedonic Controls of Food Intake and Energy Balance

Berthoud H et al. Am J Physiol Regul Integr Comp Physiol 2011;300:R1266-R1277
Emotion, Eating Behavior & Obesity

- Emotion (positive and negative) has a major impact on cognitive and psychological functions.

- Negative emotion enhances the shift in food choice from healthier foods to comfort foods. Emotions can increase the quantity of food consumed as well.
Affect, Eating Behaviors and Energy Balance: Feedback

Affect

- Improves mood (reduced arousal and irritability) and decreases stress, escape from aversive self-awareness.

Diet: ↑ Fat, Sweet Energy Dense

- ↑ HPA activity, ↓ dopamine
- Executive function: ↑ impulsivity, ↑ hedonic eating

HPA activity, ↑ serotonin & dopamine availability
Eating habits related to emotions

- Limited capacity hypothesis: when restrained eaters' cognitive capacity to maintain restricted food intake is limited by positive or negative emotional stimuli, food intake increases.

- Emotional eating theory: ability to regulate negative emotions by eating high fat, and carbohydrate “comfort foods”.

Emotion and Eating Behavior

- Restrained eating
- Impairment of cognitive eating controls
- Emotional eating
- Eating to regulate emotions
- Increased food intake
- Increased intake of sweet, high fat foods
Stress and Eating Behavior

More hungry during stressful period

Less hungry during stressful period

“COMFORT” FOODS

“HEALTHY” FOODS

Eat more of

Eat less of

Sweets and Chocolate
Cake and Biscuits
Savory snacks

Bread
Fruit and Vegetables
Meat and Fish

Normal Intake

TRENDS in Endocrinology & Metabolism
What extent can a high fat diet protect from stress-induced anxiety and depressive-like symptoms? What is the underlying mechanisms?

What is the relationship between timing of a high fat diet and the emotional effects of eating?

What are the effects of positive emotions on eating behaviors? Are different hormones/neurotransmitters involved?
Are there other emotions that are sensitive or not sensitive to modulation by diet? What is the mechanism?

What specific therapeutic interventions could impact/change dietary intake during the prevention, treatment, and post-treatment of obesity and cancer?
Energy Balance and Affect: Physical Activity
Existing evidence: Affect → Physical Activity (PA)

- **Mood disturbance (Clinical)**
  - Very low levels of PA
  - Very high degree of sedentary behavior
  - Low “predicted” fitness and exercise tolerance

- **Negative affect (non-clinical)**
  - Low levels of PA
  - High degree of sedentary behavior
  - Low exercise tolerance

- **Cancer Survivors**
  - Low levels of PA during treatment
  - Treatment & negative affect related to PA
Existing evidence: Physical activity → Affect
Exercise and Affect Studies Summary
(1st generation studies)

Mode:
Aerobic & weight training appear equally effective.

Frequency:
Mental health improvement limited after 3 bouts/wk.

Duration:
Mood effects with as little as 5 minutes; 30min optimal.

Intensity:
Moderate/low intensity better than high.

Program Length: Longer program related to better effect.
Newer Generation Studies

Focus on affect reactivity to exercise and exercise adherence,

Focus on positive affect rather than alleviation of negative affect

Measurement of general emotional response (i.e., good/bad) to exercise versus distinct emotions

Do not merge affect with physical state (e.g. “fatigue”).

Intensity based on physiological relevancy (i.e., ventilatory threshold rather than percent of maximum)

Focus on affective response to exercise session (during not only delayed pre-post measurement)

Statistical modeling captures greater individual variability
<table>
<thead>
<tr>
<th>Exercise Attribute</th>
<th>Affect Response</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Mode</strong></td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Intensity</strong>&lt;sup&gt;a&lt;/sup&gt;</td>
<td>Rated as pleasurable</td>
</tr>
<tr>
<td>LOW: &lt; ventilatory threshold (VT)</td>
<td>Variable Response</td>
</tr>
<tr>
<td>Moderate: at VT</td>
<td>Self-set: rated as pleasurable; Prescribed: Variable response</td>
</tr>
<tr>
<td><strong>Duration</strong>&lt;sup&gt;(session)&lt;/sup&gt;</td>
<td>15 - 30 min: limited testing 60+ Min: possibly becomes aversive</td>
</tr>
<tr>
<td><strong>Frequency</strong></td>
<td>n.s.</td>
</tr>
<tr>
<td><strong>Program Length</strong></td>
<td>n.s.</td>
</tr>
</tbody>
</table>
Adaptation of Dual –Mode (Circumplex) Model

Figure 1 — A model of exercise intensity, affective response, and exercise adherence.

**Exercise-Affect and Adherence Studies**

**Williams et al, 2008 (sedentary, overweight, adults)**
- Pleasure (Feeling State [FS]): at 2-min. walk test
- Correlations with minutes of physical activity
  - $R = .50$ @ 6-month follow-up
  - $R = .47$ @ 12-month follow-up
- 1 unit increase in FS --> additional 38min of PA

**Schneider et al, 2009 (adolescents)**
- Pleasure (Feeling State [FS]): 30-min. cycling @ 80% VT
- Participants who reported:
  - ↑ Pleasure: 54min. PA by accelerometer
  - ↓ Pleasure: 40min. PA by accelerometer
- 1 unit increase in FS --> additional 4.8min of PA
Filling the Gaps: How affective science can inform PA research

- Basic theory-testing related to exercise elicited affect (e.g., self-paced vs. prescribed exercise; social & environmental setting; person-factor interactions...etc).

- Does the acute emotional response to exercise predict later adherence? If so, what are implications for intervention (e.g., triaging, manipulating exercise setting...etc)?

- Are there important distinctions in evoked emotional response to physical activity, exercise, and sedentary behavior? Implications for intervention?
Filling the Gaps: How affective science can inform PA research

- What is role of exercise elicited affect in multiple behavior change paradigm (e.g., smoking)