Fighting Against Cancer
Using a Plant-Based Diet

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Objectives

• To increase awareness of the health implications of plant-based dietary practices.
• To assess and summarize current research on plant-based diets as it applies to cancer prevention and overall health promotion.
• To explore and discuss the various applications of plant-based diet research to clinical and public health practice.
What is a plant-based diet?

Plant-Based Diet or Lifestyle
An eating pattern dominated by fresh or minimally processed plant foods and a decrease in consumption of meat, eggs and dairy products.

How does plant-based compare to other ways of eating?
- Vegan - an entirely plant-based diet with absolutely no food from animal sources
- Vegetarian - a plant-based diet that may include eggs or dairy
- Macrobiotic - a plant-based diet with occasional seafood but no dairy
- Semi-vegetarian or "flexitarian" - a plant-based diet including occasional meat and dairy
Who is promoting a plant-based diet for cancer prevention?

American Cancer Society

“For the majority of Americans who do not smoke, the most important ways to reduce cancer risk are

- to maintain a healthy weight
- be physically active on a regular basis
- eat a mostly plant-based diet that limits saturated fat.”
National Cancer Institute

- "Eat a plant-based diet, with at least 5 servings of fruit and vegetables a day. Have several servings a day of beans and grain products (such as cereals, breads, and pasta). Eat less meat."

American Institute of Cancer Research

**RECOMMENDATIONS**

**BODY FATNESS**
Be as lean as possible within the normal range of body weight

**PHYSICAL ACTIVITY**
Be physically active as part of everyday life

**FOODS AND DRINKS THAT PROMOTE WEIGHT GAIN**
Limit consumption of energy-dense foods
Avoid sugary drinks

**PLANT FOODS**
Eat mostly foods of plant origin

**ANIMAL FOODS**
Limit intake of red meat and avoid processed meat

**FOODS AND DRINKS THAT PROMOTE WEIGHT LOSS**
Limit consumption of energy-dense foods
Avoid sugary drinks

**PERSONAL RECOMMENDATIONS**

**CONSUME ENERGY-DENSE FOODS SPARINGLY**
Avoid sugary drinks

**CONSUME "FAST FOODS" SPARINGLY, IF AT ALL**

**EAT AT LEAST 5 Servings of a Variety of Non-starchy Vegetables and Fruits Every Day**

**EAT RELATIVELY UNPROCESSED GRAINS AND LEGUMES WITH EVERY MEAL**

**LIMIT REFINED STARCHY FOODS**
Diets high in fruits and vegetables may have a protective effect against many cancers.

- Recommend a minimum of 400g (~5 servings) of fruit and vegetables per day for cancer prevention.
“…appropriately planned vegetarian diets, including total vegetarian or vegan diets, are healthful, nutritionally adequate, and may provide health benefits in the prevention and treatment of certain diseases.”

“…vegetarians tend to have a lower body mass index and lower overall cancer rates.”

What about a plant-based diet for cancer survivors?

- "Well-balanced plant-based diets are appropriate for cancer survivors"
- Cancer survivors may still harbor undetected primary or disseminated cancer cells
  - Plant-based diets reduce stimulation of growth and spread of remaining tumor cells
- Survivors in remission remain at increased risk for recurrence or other new primary cancers
  - Antioxidants provide maximum protection against new primary tumors
How does a plant-based diet help reduce cancer risk or recurrence?
What role do antioxidants play in cancer?

- Protect cells from damage caused by unstable free radical molecules.
- Free radicals bounce around and knock out pieces of DNA leading to cell mutation (like pin-ball machine).
- Antioxidants help stabilize free radicals by donating electrons to them to calm them down.
- Antioxidant Examples: beta-carotene, vitamin C, vitamin E, selenium, lycopene.
Plant-foods rich in antioxidants may prevent cancer by --

- Suppressing free radical production
- Protecting genetic material from carcinogenic agents
- Inhibiting hormone-dependent steps in tumor formation
- Serving as bulking agents that dilute carcinogens and decrease gastrointestinal transit time
- Stimulating physiologically active anti-cancer enzymes involved in detoxification processes

Biologists show veggies fight cancer

- Epigenetic changes are reversible heritable changes that have potential to alter gene expression
- Review article describes how several bioactive compounds in foods can suppress gene aberrations that over time cause tumorigenesis
- Bioactive antioxidant compounds can
  - alter mechanisms required for gene activation or silencing
  - activate tumor suppressor genes
  - inhibit tumor promoting genes

Curcumin (turmeric, curry) facilitates cell cycle arrest and induction of cellular apoptosis in various cancer cell lines
- Sulforaphane (crucifers) induces several mechanisms to prevent cancer including cell cycle arrest, apoptosis, and phase 2 detoxification
- Resveratrol (grapes, red wine) modulates signal transduction pathways that control cell division and growth, apoptosis, inflammation, angiogenesis, and metastasis
- Genistein (soy) not only reactivates tumor suppressor genes through epigenetic modifications but also inhibits expression of tumor promoter genes

“... it is clear that bioactive antioxidant dietary components hold great potential not only in the prevention but also in the therapy of a wide variety of cancers by altering various epigenetic modifications.”
DNA methylation is a process that:
- controls healthy expression of genes
- works to maintain proper cell function
- supports healthy clearance of mutated cancer cells

When DNA methylation is blocked it may lead to increased risk of conditions including cancer, CVD, and neurodegenerative disease.

Foods containing sulfur groups help foster DNA methylation.
- Crucifers (broccoli, cauliflower, cabbage, Brussels sprouts), garlic & onions, soy

“Sulfur and sulforaphane epigenetically modulate genetic expression and may regulate gene expression as a prostate cancer chemopreventive agent.”

Caveolin-1 (Cav-1) is a protein that suppresses tumor growth if present in DNA.
- If Cav-1 (-), then free radical production in breast CA tumors increases and leads to 300% increase in cell replication and tumor growth.
- Women with triple-negative breast CA:
  - If Cav-1 (+), then >75% likely to be alive 12 years after diagnosis
  - If Cav-1 (-), then <10% likely to be alive 5 years after diagnosis.

Antioxidants help to slow rampant free radical production that occurs without Cav-1 expression.

“This study provides the necessary genetic evidence that reducing oxidative stress in the body will decrease tumor growth.”

Multi-institutional randomized controlled trial of dietary change
3088 women previously treated for early stage breast cancer
Enrolled between 1995-2000 and followed through 2006
Randomized to 2 different diets rich in fruits and vegetables:

**8-a-day**
- 5 servings of veggies + 16oz veg juice
- 3 fruit servings
- 30g fiber
- 15-20% fat
- Monthly phone consults
- Newsletters
- Cooking classes

**5-a-day**
- 5 servings of fruits & veggies
- >20g fiber
- <30% fat
- Pamphlets
- Newsletters
- Cooking classes

<table>
<thead>
<tr>
<th></th>
<th>Baseline</th>
<th>Year 1</th>
<th>Year 3</th>
<th>Year 6</th>
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<tbody>
<tr>
<td>Fru/Veg g (d)</td>
<td>7.4</td>
<td>12.0</td>
<td>10.3</td>
<td>9.2</td>
</tr>
<tr>
<td>Fiber g (g)</td>
<td>21.1</td>
<td>29.1</td>
<td>26.1</td>
<td>24.2</td>
</tr>
<tr>
<td>Kcal/d</td>
<td>1719</td>
<td>1603</td>
<td>1523</td>
<td>1538</td>
</tr>
<tr>
<td>% fat kcals</td>
<td>28.5</td>
<td>22.7</td>
<td>25.4</td>
<td>28.9</td>
</tr>
<tr>
<td>Body wt (lb)</td>
<td>161.7</td>
<td>160.6</td>
<td>162.6</td>
<td>163.0</td>
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</tbody>
</table>

* = p <.001 between groups

**WHEL Study Fat Intake (% of energy)**

- Comparison
- Intervention (8-a-day)
- (5-a-day)

Never achieved a low-fat diet <20% kcals

Target range: 28.7%
WHEL Study Results

- No significant difference in progression of cancer
  - 16.7% of 8-a-day group vs. 16.9% of 5-a-day group experienced an invasive breast cancer event ($p = 0.63$)
- No significant difference in mortality
  - 10.1% of 8-a-day group vs. 10.3% of 5-a-day group died ($p = 0.43$)
- “…adoption of a diet that was very high in vegetables, fruit, and fiber and low in fat did not reduce additional breast cancer events or mortality.”

WHEL Study Results

- A randomized trial of the effect of a plant-based dietary pattern on additional breast cancer events and survival: The Women’s Healthy Eating and Living (WHEL) Study.
- Blood samples were collected during enrollment and again at years 1, 2, 4, and 6.
- Blood was analyzed for plasma carotenoids (alpha-carotene, beta-carotene, lutein, lycopene, and beta-cryptoxanthin).
- Women who consumed diets richest in carotenoids had a 33% less chance of developing recurrence or new primary breast cancer vs. those whose diets were lowest in carotenoids.

- These results suggest that longer-term exposure to a high vegetable and fruit dietary pattern that promotes higher plasma carotenoid concentration may improve prognosis and survival.
WINS (Women’s Intervention Nutrition Study)

- 2,437 women treated for early-stage breast cancer recruited
- Randomly assigned to two different groups
- Intervention group:
  - Goal: fat intake <15% of total kcal
  - 8 biweekly, 1-hour counseling sessions to learn about low-fat eating plans
  - Kept own written records of daily fat gram intake
  - RDs contacted or met with women every 3 months
  - Optional monthly dietary group sessions
- Control group:
  - Met with RD at beginning and contacted again every 3 mos

WINS Results

<table>
<thead>
<tr>
<th>Intervention Group</th>
<th>Control Group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Averaged 20.3% fat in diet</td>
<td></td>
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<tr>
<td>Weighed about 6 pounds less after 5 years</td>
<td></td>
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<tr>
<td>9.8% had some form of relapse</td>
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<tr>
<td>Averaged 29.2% fat in diet</td>
<td></td>
</tr>
<tr>
<td>Weighed about the same after 5 years</td>
<td></td>
</tr>
<tr>
<td>12.4% had some form of relapse</td>
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</table>

Women in intervention group had a 24% lower risk of relapse than those in control group

“The WINS results indicate that a lifestyle intervention designed to reduce dietary fat intake can be successfully implemented in women with early-stage, resected breast cancer receiving conventional cancer management in a multicenter clinical trial setting.”
Case-control study involving 124 women with ovarian CA vs. 696 healthy women. Diet was assessed with a detailed food-frequency questionnaire. Compared to women whose diets were lowest in the following, women who consumed diets richest in:
- Carotenoids = 67% less chance of developing ovarian CA
- Plant sterols = 58% less chance
- Fiber = 57% less chance
- Lignans = 57% less chance
- Vegetables = 53% less chance

"These results support a protective effect on ovarian cancer of phytoestrogen intakes, and our results support the hypothesis that a plant-based diet may be important in reducing risks of hormone-related neoplasms."

Nutr Cancer. 2003;133:1307-42

Evaluated data from network of multi-centric Italian case-control studies (~10,000 people with cancer vs. ~16,000 controls). Diets analyzed for 6 classes of flavonoids (isoflavones, anthocyanins, quercetin, catechins, etc.) in foods consumed over two years. People who consumed diets richest in flavonoids (vs. those who ate diets low in flavonoids) had:
- 62% less chance of developing esophageal CA
- 44% less chance of developing oral CA
- 40% less chance of developing laryngeal CA
- 37% less chance of developing ovarian CA
- 33% less chance of developing colorectal CA
- 31% less chance of developing renal CA
- 19% less chance of developing breast CA

"The findings from this large network of Italian case-control studies have provided support for an apparent protective role of flavonoids."

Nutr Cancer. 2016;65:677-677
23,658 English participants from the European Prospective Investigation of Cancer (EPIC)-Norfolk study 1993-1997
Seven-day food diaries helped identify intake of C, E, Se, Zn
Blood samples analyzed for vitamin C levels
People who consumed diets richest in C, E, and Se had 67% less chance of developing CA vs. those who ate low antioxidant diets
People whose serum vitamin C levels were the highest had 81% less chance of developing CA vs. those who had low levels of C in their blood

“If the association is causal, 1 in 12 cancers might be prevented by avoiding the lowest intakes [of antioxidants].”

93 men with early, untreated prostate cancer randomized to vegan diet group or control group
• Vegan: predominantly fruits, vegetables, whole grains, legumes, soy, ~10% kcal fat
• Control Group
After 1 year:
• Vegan Diet Group
  – PSA ↓ 4%
  – Tumor growth slowed by 70%
  – No one needed tx
• Control Group
  – PSA ↑ 6% (p=0.02)
  – Tumor growth slowed by 9% (p<0.001)
  – 6 needed tx

Should soy be a part of a cancer-fighting plant-based diet?
Benefits of soy

- Only bean that is a complete protein on its own
- Soy contains:
  - Phytic acid that can bind dangerous heavy metals
  - Alpha-linolenic acid (omega-3) that helps control inflammation
  - Isoflavones like genistein and daidzein that help protect heart & bones
- Soy also contains phytoestrogens (AKA plant estrogens)
  - Very similar in structure to human estrogen
  - Soy has high level of phytoestrogens, but only 2% of power of human estrogen
  - Phytoestrogens will bind to your cells' estrogen receptors, but can also bind up extra estrogen to keep it from working

Over 300 plant foods contain phytoestrogens: flax, sesame, wheat, oats, barley, beans, yams, apples, carrots, pomegranates

Biol Reprod. 2006;75:477-86

What types of soy should I eat?

- Traditional
  - edamame, tofu, soy nuts, soy milk
- Fermented
  - tempeh, miso, natto
- ‘Second generation’ soy products
  - veggie burgers, energy bars, TVP, meat alternatives (watch for milk additives)

Registered Dietitians can help promote plant-based diets.
The RD and the plant-based diet
American Cancer Society

- Eat at least 2½ cups of fruits and vegetables each day to help lower cancer risk
  - Rich in important vitamins, minerals, phytochemicals, and antioxidants
  - Those with the most color – dark green, red, yellow, and orange – have the most nutrients
- Try to work in a variety of fruits and vegetables every day.

Antioxidant rich foods – Grown out of the ground

- **Beta-carotene**
  - Sweet potatoes, carrots, cantaloupe, squash, apricots, pumpkin, and mangoes
- **Dark green**
  - Collards, spinach, and kale
- **Lycopene**
  - Tomatoes, watermelon, guava, papaya, apricots, pink grapefruit, blood oranges
- **Flavonoids**
  - **Yellow**: lemons, grapefruit, papaya, peaches
- **Allyl Sulfides**
  - **White**: garlic, onion, chives, asparagus
- **Anthocyanins**
  - **Blue**: blueberries, grapes, plums, eggplant
## Top 20 Antioxidant Foods

<table>
<thead>
<tr>
<th>Position</th>
<th>Food Item</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Small red beans</td>
</tr>
<tr>
<td>2</td>
<td>Wild blueberries</td>
</tr>
<tr>
<td>3</td>
<td>Red kidney beans</td>
</tr>
<tr>
<td>4</td>
<td>Pinto beans</td>
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<tr>
<td>5</td>
<td>Blueberries</td>
</tr>
<tr>
<td>6</td>
<td>Cranberries</td>
</tr>
<tr>
<td>7</td>
<td>Artichokes (cooked)</td>
</tr>
<tr>
<td>8</td>
<td>Blackberries</td>
</tr>
<tr>
<td>9</td>
<td>Prunes</td>
</tr>
<tr>
<td>10</td>
<td>Raspberries</td>
</tr>
<tr>
<td>11</td>
<td>Strawberries</td>
</tr>
<tr>
<td>12</td>
<td>Red Delicious apples</td>
</tr>
<tr>
<td>13</td>
<td>Granny Smith apples</td>
</tr>
<tr>
<td>14</td>
<td>Pecans</td>
</tr>
<tr>
<td>15</td>
<td>Sweet cherries</td>
</tr>
<tr>
<td>16</td>
<td>Black plums</td>
</tr>
<tr>
<td>17</td>
<td>Russet potatoes (cooked)</td>
</tr>
<tr>
<td>18</td>
<td>Black beans</td>
</tr>
<tr>
<td>19</td>
<td>Plums</td>
</tr>
<tr>
<td>20</td>
<td>Gala apples</td>
</tr>
</tbody>
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## Plant-Based Resources for RDNs

- Vegetarian Nutrition DPG – [www.vegetariannutrition.net](http://www.vegetariannutrition.net)
- Vegetarian Resource Group – [www.vrg.org](http://www.vrg.org)
- The Cancer Project – [www.cancerproject.org](http://www.cancerproject.org)
- Life Over Cancer – [www.lifeovercancer.com](http://www.lifeovercancer.com)
- PBSNG.org
- Plant Powered RDN: Sharonplamer.com
- The Plant-Based Dietitian (Julieanna Hever, MS, RD) – [www.plantbaseddietitian.com](http://www.plantbaseddietitian.com)

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## Summary
A whole food plant-based diet is…
- dominated by fresh or minimally processed plant foods
- rich in antioxidants and phytochemicals that over time may help reduce cancer risk and recurrence
- endorsed by numerous prominent healthcare organizations
- a diet that can be healthful, nutritionally adequate, and confidently promoted by RDNs

Thank you for your attention & hopefully for your commitment to learn about and begin teaching about a whole food plant-based diet and lifestyle!