NUTRITIONAL ISSUES CONFRONTING FEMALE ATHLETES

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OBJECTIVES

• Brief reflection of Title IX
• Nutrition Research on Female Athletes
• Current nutritional recommendations for female athletes
• What nutrition advise can the athletic trainer provide the female athlete
WOMEN WIN GOLD IN 2012!

• Before the 1970s, girls were discouraged from participating in sports

• Let’s look at two sports which changed the “game” for women.
"Below us on the cinder path were 11 wretched women, 5 of whom dropped out before the finish, while 5 collapsed after reaching the tape," wrote John Tunis of the New York Evening Post.

Other newspapers preached that women would be desexed and their reproductive capability impaired by such "terrible exhaustion."

England's Daily Mail affirmed that women who raced longer than 200m would age prematurely.
What really happened in the first Olympic women's 800m?

There were nine women in the race, not 11. All nine are recorded as having finished. None dropped out. Film footage shows only one woman falling at the finish. Not "several," which even supporters of women's running accept without question.

The 800m event on Aug. 2, 1928, blocked women's access to high-level distance racing for 30 years.
1965 and 1966 Boston Marathon

• Roberta Gibb had run the race the without a number in 1965. She had hid behind a bush at the start.

• K.V. Switzer, the first woman to run the Boston Marathon with an issued number

• By using her initials, Switzer had gone unnoticed as a woman until two miles into the race.

• That's when Race director Will Cloney and official Jock Semple physically tried to remove her from the race.
1984 Olympics: The First Time Women Competed in the Marathon

JOAN BENOIT
1968-1972 Women’s Basketball in RI

- 1968 Women played basketball  6 on 6
- 1969-1970 Home court had the choice of 6 on 6 or 5 on 5
- 1971  No State Championship
- 1972  First State Championship
TITLE IX

• Educational Amendment Act of 1972

  Is a federal anti-discrimination law

  – Mandates that any institution accepting federal funding provide equal opportunities for men and women to participate in athletic programs

Title IX signed into law by President Nixon in 1972
Were researchers interested in studying the nutritional needs of physically active women?

- Prior to 1972, female athletes were concerned with just competing. Nutrition didn’t even cross their mind.
- An early report from 1976 indicated that there were no differences between men and women with respect to metabolic responses to endurance exercise and skeletal muscle fiber type.
- As a consequence, most research in exercise physiology involved only male participants with the assumption that any results would apply to females.
Initial studies began to emerge

Low intakes of total kilocalories, iron, calcium, zinc and folate (Deuster et al., 1986)

Interpretation of those observations and their practical implications had to wait until the late 1980s

Both Men and Women

– Have the same nutrient requirements
– Possess the same physiological mechanisms for processing nutrients
The purpose of this study was to examine gender differences in repeated sprint exercise (RSE) performance among male and female athletes matched for VO2max relative to FFM (VO2 max FFM).

CONCLUSION

These data indicate that men and women with similar aerobic capacities do not respond differently to short repeated sprints but may differ in their ability to recover and perform sprints of longer duration.
TODAY’S FEMALE ATHLETE IS MORE INFORMED ABOUT NUTRITION BUT...
.. HAVE LOW NUTRIENT INTAKES

• Individual not eating enough
• Making unhealthy food choices
• Females are tempted to restrict energy intake to achieve a physical appearance.
• Energy expenditure is greater than energy intake
• Many females fit into this risk group
Problems Associated With Negative Energy Balance

- ↓ LBM
- ↓ Metabolism
- ↑ risk of injury
- ↓ ability to fight off infection/illness
- ↓ restorative sleep
- ↑ short and long term fatigue
- Poor recovery and adaptation to training
- Poor performance
- Loss of motivation
- Female athlete triad???
MATCH ENERGY INTAKE OF ATHLETE WITH DEMANDS OF TRAINING AND ENERGY INTAKE REQUIREMENT FOR DAILY LIVING
HEALTHY FEMALE

- Energy balance at 45 kcal/kg (125# female = 2,551 kcal)

- Reproductive function and bone turnover impaired if less than 30 kcal /kg (125# female = 1,701)
  - decrease in energy availability by 33%

Ilhe R, Loucks AB. J Bone Miner Res 19:1231-40,2004
Loucks AB, Thuma JL. J Clin Endocrinol Metab 88:297-301,2003
A healthy diet or meal plan is considered a 

- balance of energy producing **macronutrients** (carbohydrates, fats and protein)
- non-energy producing **micronutrients** (vitamins, minerals and water)

**ALL** which provides **adequate calories**
- to achieve body weight goals
- supply essential (from food) nutrients
- maintain **hydration**
GOAL: TO POSITIVELY AFFECT HEALTH AND PERFORMANCE

• However, someone might want to decrease body fat BUT

if energy intake is low and
if energy expended in exercise too high

• End result may be a decrease in muscle mass in addition to body fat, which may result in a decrease in

  strength     speed     endurance

A dietary intake less than 1500 calories/day is required to prevent a vitamin or mineral deficiency.
• Determining energy intake
  – Cunningham Formula
  – Harris Benedict Formula
• Use the dietary exchange system
• Encourage dietary change during the off season
• Posters or food models or pamphlets available in the athletic training room
Provide athletic trainers with recommendations for:

- safe weight loss and weight maintenance practices for athletes and active clients and
- to provide athletes, clients, coaches and parents with **safe guidelines** that will allow athletes and clients to achieve and maintain weight and body composition goals.
Athletes male or female require carbohydrate, protein and fat-containing foods daily

- An athlete’s diet cannot omit a whole food group i.e. low carbohydrates-high protein diet

- A bowl of cereal and milk can provide B-vitamins, protein and dairy and grains. Add a banana and we can add fruit to the list.

*FACT:* Cereal is composed of carbohydrates and some protein. Milk is a combo of carbohydrate, protein and some fat (% varies). Fruit provides vitamins and minerals.
MACRONUTRIENT INTAKE

- Carbohydrate intake is dependent on athlete’s size and activity level.

<table>
<thead>
<tr>
<th>Type of Activity</th>
<th>Intensity Level</th>
<th>Carbohydrate Target</th>
</tr>
</thead>
<tbody>
<tr>
<td>Light</td>
<td>Low intensity or skill based activity</td>
<td>3-5 grams/kg/d</td>
</tr>
<tr>
<td>Moderate</td>
<td>Exercise program (1 hour/day)</td>
<td>5-7 grams/kg/d</td>
</tr>
<tr>
<td>High</td>
<td>Endurance (1-3 hours /day)</td>
<td>6-10 grams/kg/d</td>
</tr>
<tr>
<td>Very High</td>
<td>Extreme commitment (&gt; 4-5 hours/day)</td>
<td>8-12 grams/d</td>
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Carbohydrate Loading for Females??

- The overall conclusion from several studies is that fat oxidation is higher and carbohydrate oxidation is lower in women than men during steady state endurance exercise.
- From the observation that carbohydrate oxidation is lower in women, Tarnopolsky and colleagues performed studies to determine whether or not women would benefit from carbohydrate loading prior to exercise.
- The higher fat oxidation observed in women coincides with a greater intramuscular triglyceride content and increased lipolysis during exercise.
- This sex difference in fat metabolism is likely attributed to the effects of estrogen.

PROTEIN

• The amount of protein required depends on the type of activity being performed
• RDA for protein is .8g/kg of bw/d
• The female endurance athlete should consume 1.2-1.4 g protein/kg of bw/d
• 1.6-1.7 g/kg of bw/d is recommended for the strength-trained athlete
• CONCERN: Vegetarian Athlete
LARGE AMOUNT OF DIETARY PROTEIN???

- **IF DIET IS POOR - PROTEIN IS USED FOR FUEL**
  - EXPENSIVE FUEL (5%-7% of energy)

- If diet is healthy - amino acids are used for their intended purpose...muscle building and recovery

- **BODY DOES NOT STORE PROTEIN**
  - **BODY NEEDS TO EXCRETE EXCESS PROTEIN FROM THE BODY (NITROGEN)**
TAKE HOME MESSAGE REGARDING PROTEIN

• Individuals don’t realize how much protein they are actually ingesting
  – 2 slices of bread (6 gms)
  – 2 tablespoons of peanut butter (8 gms)
  – 2 cups of milk (16 gms)
  • Total - 30 gms

• Recommendation .8 g/kg/bw per day
  – 130#s/2.2 = 59 kg
  – 59kg x .8 = 47 grams
FAT

• Dietary fat provides essential elements for the cell membranes and is essential for the absorption of fat-soluble vitamins (ADEK)

• AMDR recommendation for fat: 25-35% of a person’s energy intake

• Limit daily intake of Trans fats and Saturated Fats

• Include essential fatty acids in adequate amounts: of Omega-6 (alpha-linoleic acid - 1.1g /d) and Omega-3 (linoleic acid-11-12 g/d)
Low – Fat Diets

- Do not recommend for active individuals
- Low-fat diets decrease energy and nutrient intake, reduce performance and decrease oxidation of body fat stores.
- Providing the largest amount of kcals/g (9 kcals/gram) among the macronutrients, fat allows for:
  - A positive energy balance
  - Maintenance of sex hormone concentration
  - Possible avoidance of menstrual disturbances
Energy Deficit, Menstrual Dysfunction and Poor Bone Health

• Assessed weight stable female runners with (IR) and without menstrual disorders (R)
• Daily energy intake was significantly lower in the IR athletes than R athletes
• IR athletes had lower levels of freeT₃ which may indicate a depressed BMR
• Mean energy intake of CHO and PRO were similar however FAT intake was significantly lower in IR
• Decreasing dietary fat intake with the hope of maintaining low body weight; even though increasing it would improve reproductive function

**Figure 1.** The relationship between body fat and performance. 

A. The misconception is that a highly negative correlation exists with any body fat as excess. 

B. Optimal body fat is a range based on individualized performance and nutrition needs.
Female Athletes are at Risk for Vitamin and Mineral Deficiencies

- Iron
- Calcium
- Vitamin B
- Vitamin D
Iron supplementation may be warranted under certain circumstances such as

- Low energy availability
- Pregnancy
- Menopause
- A risk of low bone mass
Why are athletes at increased risk for iron deficiencies?

- Low dietary intake
  - Vegetarians beware
- Increased demand for hemoglobin and myoglobin due to training and sport
- Loss through sweat
- Mechanical hemolysis (foot-strike)
SPORTS ANEMIA

• 60’s and 70’s referred to increased red cell destruction in active people thus it was thought: active people were deficient iron

• Research: Individuals with low iron status did not respond to iron supplementation

• Not everyone who presents with low iron status indices has an iron deficiency.

• TRANSIENT CHANGES IN IRON STATUS
IRON DEFICIENCY vs. ANEMIA

- Iron deficiency anemia occurs when there is too little iron to synthesize adequate amounts of hemoglobin.
  - Decrease in the amount of stored iron. Cannot carry enough oxygen from lungs to tissue
  - ↓ energy metabolism
  - ↑ in fatigue, weakness, headaches, apathy, pallor (RBC are small and pale) and poor resistance to colds
  - Low iron levels in blood plasma
- Anemia is the last stage of iron deficiency
- *Early stages have no symptoms because they do not affect the amount of iron in RBC but the levels are low*
- Only after plasma levels drop that there is no longer enough iron to maintain hemoglobin in RBCs
STAGES OF IRON DEFICIENCIES

• STAGE ONE – decreased iron stores, reduced ferritin level and no physical symptoms.
• STAGE TWO - decreased iron transport, reduced ferritin, reduced production of heme, physical symptoms include reduced work capacity.
• STAGE THREE – iron deficiency anemia, decreased production of normal red blood cells, reduced production of heme, inadequate hemoglobin to transport oxygen. Symptoms include pale skin, fatigue, and reduced work performance, impaired immune and cognitive functions.
CASE STUDY: Female cross-country/track/field athlete (5,000 and 10,000 meters)

• Vegetarian
• Normal menses
• Wanted to lose five pounds
• Complained of fatigue, shortness of breath during exercise, intolerance to cold and inability to fully recover between training runs
• Lab work and hemoglobin 10.3g/dL, hematocrit 34 percent, transferrin 371mg/dL and ferritin 8 ng/mL
• Dietary iron: 8.2mg/d
• Physician Diagnosis: iron deficiency (stage two)
• Medication: 325 mg of ferrous sulfate (qd) for three months

Rosenbloom, Christine, (2012) T&C (12)
Explanation of Symptoms

- Lack of iron from food choices - decreased oxygen to muscles
- Iron depletion – cold intolerance and reduced exercise endurance
- Low intake of carbohydrates (192 grams/d) and protein (1.1 gram/kg/bw) – replenish glycogen stores in her muscles post workout and the inability to produce iron-carrying proteins and hemoglobin synthesis
- Low energy intake: 1,600 kcals/d
Dietary Changes

• Total energy: 2,600 to 2,800 kcal/d
• Total carbohydrate: 5 – 7 g/kg/bw/d
• Total protein: 1.5 g/kg/bw/d
• Total iron: 15 mg/d
• Increase vitamin C intake from food to enhance iron absorption
• Avoid foods which inhibit non-heme iron absorption: coffee, tea and cocoa
POOR IRON STATUS??

- GENDER (females in endurance sports or aesthetic sports)
- Is there a history of iron deficiency?
- Is she a vegetarian?
- Does the individual have low iron intakes, especially heme iron?
- Are there dietary factors that decrease iron absorption?
- Has the athlete just increased her exercise training or initiated an exercise program?
- Was iron status normal before exercise was increased?
- Does the athlete respond to iron supplementation or to increased iron in the diet?
  - Good response to supplementation-low iron status due to inadequate iron
  - Poor response to supplementation-low hemoglobin due to dietary factors or transient issues
- Are there increased blood losses?
- Do not encourage self-diagnosis or self-medication
VITAMINS AND ENERGY

• B-COMPLEX VITAMINS: thiamin, riboflavin and niacin are involved in energy reactions
• Without vitamins enzymes could not function and the body could not produce energy
• Role of energy production is INDIRECT not direct.
• Deficiency in B-vitamins = fatigue
Energy Production

- Can a mild B vitamin deficiency affect energy production?
- Can increasing the amount of B vitamin increase energy metabolism in well-nourished athletes?
  - Mild vitamin B deficiency does not result in decreased performance but moderate vitamin B deficiency could.

Lukaski, 2004
Energy Production

• Deficiencies usually accompanied by
  – Low calorie intake
  – Low intake of other nutrients

• Thus taking the B vitamins will resolve the deficiency but not the low intake of CHO or PRO

• Therefore, athletes lacking B vitamins should increase the calories, consume CHO and vitamin rich FOODS.
ENERGY PRODUCTION

• By increasing the intake of fruits, vegetables, whole grains, beans and lean protein foods such as fish and nonfat milk, athletes could resolve all the nutrient-related problems, not just the B vitamin-related ones.
• Consuming an excess of B vitamins does not result in the speed at which enzymes release energy or the production of more energy.
• Past the point of saturation, the body will excrete excess B vitamins.
• Therefore, an athlete who consumes a sufficient amount of the various B vitamins in food would not benefit from supplementation.
Calcium, Vitamin A and D

• An adequate nutritional status is crucial to bone health.

• Calcium and vitamins A and D have significant affects on bone metabolism.

• Calcium is essential for bone formation and improves BMD at all ages. Whether absorbed in the skin by way of the sun or ingested orally through food, vitamin D preserves skeletal stores of calcium and is an essential component for bone metabolism.

• High doses of vitamin A stimulate osteoclast activity and results in bone breakdown.
• Additionally, these high doses of vitamin A can interfere with vitamin D.
• An overall poor nutritional status may affect bone metabolism through the effects of leptin, which is mediated centrally.

Leptin Receptors and Bone Health

• Leptin receptors have also been found in bone and may be important to osteoblastic function. Thus, the dieting in athletes, independent of the low estrogen secretion may independently affect bone metabolism and lead to osteoporosis by as of yet unidentified mechanisms.

Studies on vitamins and minerals

- Calcium and vitamin D are important for bone health
- Exercise can increase the loss of calcium through sweating
- RDA for calcium will be higher for female athletes than mildly active women
Vitamins and minerals are abundant in fruits and vegetables.

- Don’t encourage intake of individual vitamins
- Remind: split calcium supplement am/pm
- Encourage Salads, Fruits and Vegetables
- Travel foods
  - Bananas
  - Apples

Test bioavailability of supplement with ¼ cup of vinegar

ROLE OF ATHLETIC TRAINER
• Inadequate dietary intake is the primary nutritional concern of today's female athlete.
• As these athletes fail to consume enough energy to support the physical demands of training, they become at risk for disordered eating, amenorrhea, and osteoporosis, conditions collectively identified as the female athlete triad.
Consequences of energy imbalance

- Reduced energy availability
  - Menstrual irregularities
    - Subfertility/Infertility
  - Uncoupling of bone formation and resorption
    - Low BMD
Unsafe weight management practices can compromise athletic performance and negatively affect an individual's health.

Athletes and physically active individuals often attempt to lose weight by not eating, engaging in unhealthy weight control behaviors and restricting fluids.
1997 ACSM Position Statement: The Female Athlete Triad

• Definition:

  – Syndrome that can develop in physically active girls and women with three interrelated components:
    • Disordered eating
    • Amenorrhea
    • Osteoporosis

2007 ACSM Position Stand: Female Athlete Triad

• New definition is: **Disordered eating**, **Menstrual Dysfunction** and **low bone mineral density (LMD)**

• Revised definition and recommendations in 2007

• Increased emphasis on “energy availability”

• Remember LMD in young athletes causes peripheral stress fractures vs. central stress fractures

Low Energy Availability/Disordered Eating

Female Athlete Triad

Bone Loss/Osteoporosis

Menstrual Disturbances/Amenorrhea
CONTINUUM

FEMALE ATHLETE TRIAD COALITION
Accessed November 15, 2012
2008 National Athletic Trainers’ Association Position Statement

Preventing, Detecting, and Managing Disordered Eating in Athletes
Disordered Eating

• May be intentional or unintentional
  – Lose a few pounds before an event
  – “Inadvertently failing to balance energy expenditures with adequate energy intake”
Disordered Eating

• Includes a wide spectrum of unhealthy eating behaviors
  – Skipping meals or limiting calorie intake
  – Restricting certain foods such as those high in fat or protein
  – Binge eating or purging
  – Diet pills, laxatives, diuretics
  – Anorexia nervosa and bulimia nervosa
• Disordered eating can lead to eating disorders
• “A meatless diet may also act as a smoke screen for restrictive eating behaviors. Many females with eating disorders do not eat meat.”
  – A claim to be a vegetarian should be a red flag for athletic trainers if other symptoms exist

DIABETICS AND EATING DISORDERS

- Diabetics and eating disorders - DIABULIMIA*
- Both groups classify foods as good and bad
- Diabetic’s classification is based on carbohydrates and sugars whereas anorexic’s and bulimic’s is based on fat
- Both carefully monitor the timing and content of meals.
- Both have control issues
- Some with diabetes deliberately avoid injecting insulin as a form of weight control
- Estimates that 1/3rd of young women with diabetes lose weight by intentionally omitting insulin injections or not taking enough insulin

Rudall et al. (1997) New England Journal of Medicine, 336(26), 1849-1854
*Darbar & Mokha (2008) Ath. Ther Today 13 (4) 31-33
Energy Availability

• The bone connection
  – Estrogen suppresses osteoclast activity so bone loss in amenorrheic women was originally attributed to hypoestrogenism
  – However, estrogen replacement has not fully restored bone density in clinical trials
  – Low energy availability may have a direct effect on bone
    • Ihle and Loucks showed that markers of bone formation and resorption changed unfavorably in sedentary women exposed to low energy availability (below 30 kcal/kg FFM per day)

Amenorrhea

- Eumenorrheic athletes restrict energy availability by 30%
- Amenorrheic athletes restrict energy availability by 44-67%

Amenorrhea

- **Primary Amenorrhea** = no menses within 4 years of the start of menarche by age 15 or 16.
- **Secondary Amenorrhea** = no menses continuously for 3-6 months.
- **Oligomenorrhea** = 4? 9? or fewer menstrual cycles in the preceding 12 months or cycle no longer than 45 days.
- NOTE: Amenorrhea associated with exercise is hypothalamic in origin.
Amenorrhea

- Low body weight and low body fat
- Exercise stress theory
- Energy availability theory
Secondary amenorrhea and stress fractures

- Association of secondary amenorrhea and stress fractures
- Nattiv et al was unable to demonstrate this association in track and field athletes
- She was able to demonstrate an association of lower extremity stress fracture and lower bone mineral density of the lumbar spine

Nattiv et al, Physical Medicine and Rehabilitation 2010 Volume 2 (8) August
Assessment of Nutritional Knowledge in Females Susceptible to the Female Athlete Triad (FAT) Syndrome

• 48 regional endurance athletes, 11 Trampoline gymnasts and 32 untrained controls.
• Individuals were classified as being ‘at risk’ or ‘not at risk’ and nutritional knowledge scores were compared for the two groups using the GNKQ, EAT-26 survey measures of PA, Menstrual and skeletal injury history.
• The lack of difference in nutrition knowledge between ‘at risk’ and ‘not at risk’ athletes suggest the lack of information is not accountable for restricted eating associated with FAT.

Raymond-Barker et al J Occup Med Toxicol 2007 Sep 27;2:10
Nutritional Factors that Influence Change in BMD and Stress Fractures

- 125 Female distance runners ages 18-26
- Dietary variance associated with food frequency records
- Low-fat dairy products and major nutrients in milk (Calcium, vitamin D and Protein) were associated with greater BMD and a lower incidence of stress fractures
- Potassium intake was also associated with greater gains in hip and whole body BMD

Nieves et al PMR 2010 Vol 2 (8)
BMD and Stress Fracture

- Stress fracture generally associated with lower BMD in military women

- History of amenorrhea, smoking, white race, and family history of osteoporosis
Why DXA?

• Accessible
• Precise
• Rapid to perform
• Low radiation

Keith J. Loud, MD, MSc, FAAP
Adolescent & Sports Medicine
Children’s Hospital at Dartmouth
TREATMENT

PHARMACEUTICALS

- Calcitonin (also known as MIACALCIN) and CALCITONIN-SALMON – nasal spray
  - Poorly tolerated
  - Minimal effect
- Estrogen replacement therapy (ERT)

- Bisphosphonates:
  - Alendronate (also known as FOSAMAX)
  - Risendronate
  - Pamidronate
TREATMENT

• Cut training volume in half
• Increase by no more than 10% increment each week
• If no weight gain, remove from competition
Treatment

Reversible?

- "Catch Up" diminishes with age and length of amenorrhea
- Weight gain, resumption of menses and improved nutrition only treatments
- increases BMD but does not normalize

Keen AD, Drinkwater BL. *Osteoporosis Int* 7:311-315, 1997
CONCLUSION
THE ROLE OF THE ATHLETIC TRAINER

• It is up to the athletic trainer or healthcare provider to be
  – honest with their athletes
  – be sure their advice is current
  – be familiar with the nutritional and physiological demands of an athlete’s sport (plus the rules governing weigh-in procedures)
  – know when to refer the athlete to another professional, regarding topics which they are not proficient
Consultation with a board certified Sports Dietitian (CSSD) who is a registered dietitian credentialed by the American Dietetic Association is the ideal.

However, a registered (RD) or licensed dietary nutritionist (LDN) can provide nutritional information to athletes and clients.

A qualified nutritionist whose specialty is sports nutrition could provide a lecture to a specific team or all varsity sports.

Nutrition information which is common public knowledge can be provided by athletic trainers and other health professionals.
Coaches, peers and family members should not provide information on diet, body composition, weight, or weight-management practices and should refrain from making comments on participating in the monitoring of body composition and weight

(Bonci et al, 2008)
RESOURCES FOR SPORTS NUTRITION

• **MyPlate**

• **Australian Sports Institute**

• **NCAA Nutrition and Performance website**
  – [www.ncaa.org/nutritionandperformance.html](http://www.ncaa.org/nutritionandperformance.html)
RESOURCES FOR SPORTS NUTRITION

• Sports, Cardiovascular and Wellness Nutritionists (SCAN) practice group of American Dietetic Association:

REMEMBER

NUTRITION IS THE BRIDGE BETWEEN ABILITY AND PERFORMANCE
THANK YOU!

ANY QUESTIONS
IF I TREAT YOU, I CAN HELP YOU TODAY.
IF I TEACH YOU, I CAN HELP YOU FOR A LIFETIME.

Kathleen M. Laquale  2013