

Introduction



Athletes at higher risk of eating disorders (ED)

- Females: increased risk compared to men
 - 46% in lean sports
 - 20% in non-lean sports

Lean sports

- Weight requirements or where wt. is advantageous



Eating Disorder Types



Clinical eating disorders

- Anorexia Nervosa
- Bulimia Nervosa
- Binge Eating Disorder
- ED Not Otherwise Specified

Diagnostic criteria

- American Psychiatric Association
- DSM V



Anorexia Nervosa



- Characterized by extreme dietary restriction, severely underweight, psychiatric co-morbidities
- Potential health complications
 - Cardiovascular (low heart rate)
 - Low blood pressure
 - Decreased bone density
 - Muscle loss and wasting
 - Kidney problems associated with dehydration
 - Hair loss
 - Death

Bulimia



- Characterized by frequent, recurrent binge episodes followed by compensatory behavior
- Potential Health Complications
 - Electrolyte imbalances (reduced K^+ , Mg^+ , Ca^+)
 - Edema
 - Erosion of dental enamel
 - Esophageal tears
 - Calluses on hands
 - Swelling of salivary glands

Female Athlete Triad



The Female Athlete Triad

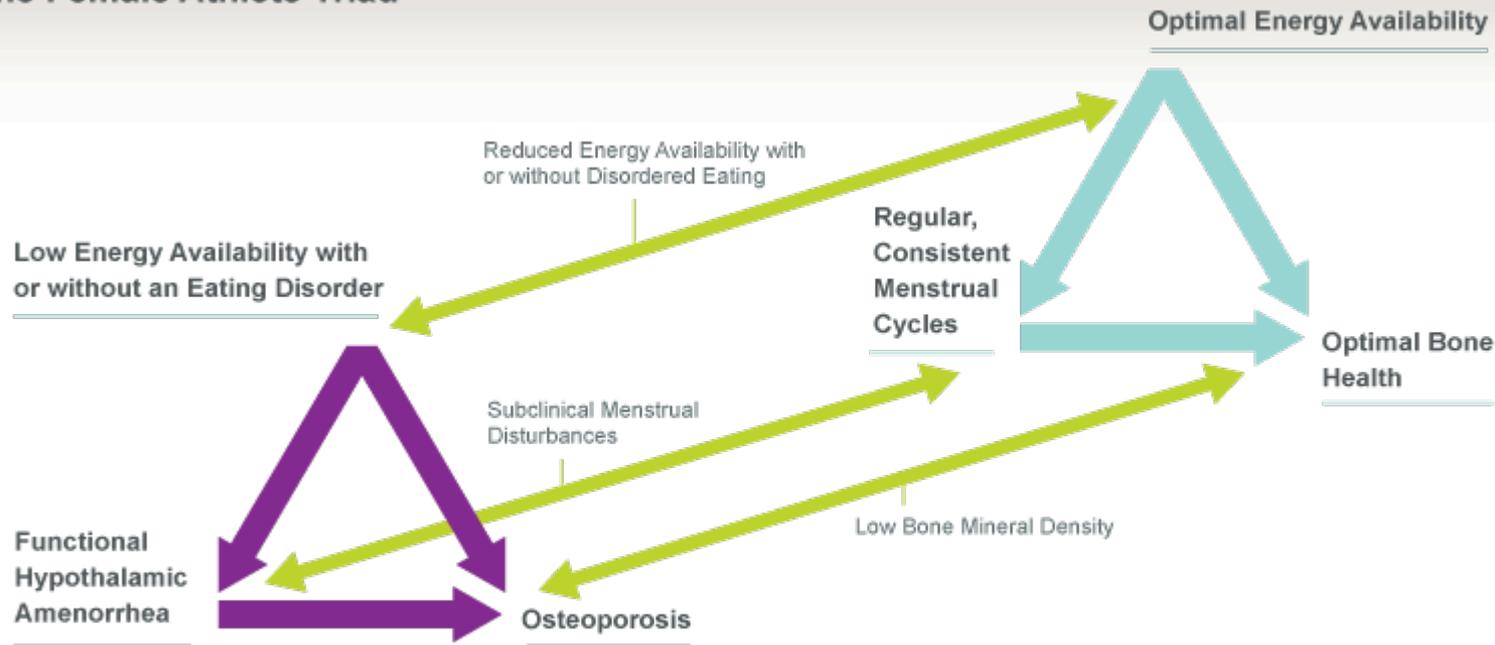


Figure 1: The spectrums of the Female Athlete Triad including energy availability, menstrual function and bone mineral density exist on a continuum between health and disease.

Multiple Triad Risk Factors and Bone Stress Injury in Female Athletes

Barrack, M., Gibbs, J., Souza, M., Williams, N., Nichols, J., Rauh, M., & Nattiv, A. (2014). *The American Journal of Sports Medicine*.



Purpose:

Determine the effect of single or combined risk factors associated with the Triad on the incidence of bone stress injuries in physically active girls and women.

Methods:

- Cohort study using four different prospective cohort studies conducted at Pennsylvania State University, University of Toronto, San Diego State University, and the University of California, Los Angeles
- 259 female subjects with complete data for all variables from each study
- Questionnaire to assess eating attitudes, demographics, menstrual function, sports participation and injury history, and pathological weight control behaviors

Multiple Triad Risk Factors and Bone Stress Injury in Female Athletes



Methods continued:

- Dual energy x-ray absorptiometry used to measure bone mass, areal bone mineral density, and bone mineral content
- Incidence of bone stress injuries
- Risk factors:
 - low body weight
 - low body mass index (BMI)
 - high-volume exercise
 - elevated dietary restraint
 - pathogenic weight control behavior
 - participation in a leanness sport
 - late age at menarche
 - oligomenorrhea or amenorrhea
 - low BMD

Multiple Triad Risk Factors and Bone Stress Injury in Female Athletes



Results:

- 28 participants sustained a bone stress injury
 - 17 stress reactions
 - 11 stress fractures
- 60% were endurance runners, 32% were track and field athletes
- Exhibited significantly lower percentages of body fat, fat mass, and BMD values
- Exercising greater than 12 hours per week and a BMI below 21 were significantly associated with developing a bone stress injury
- Dose response relationship was observed:
 - Risk of developing bone stress injury: 15%
 - Risk with one significant risk factor: 21%
 - Risk with two significant risk factors: 21%-30%
 - Risk with three significant risk factors: 29%-50%

Multiple Triad Risk Factors and Bone Stress Injury in Female Athletes



Limitations:

- Different DXA machines
- Individual training logs were not collected
 - Hours of training per week could be used as a continuous variable to determine if a dose response relationship exists between hours of training and risk of bone stress injuries
- Used only variables measured by all four studies
 - Excluded: history of a clinical eating disorder, history of bone stress injury, and history of menstrual function and body weight

Conclusions:

- Study showed that as the number of Triad related risk factors increase, so does the risk of bone stress injury in female athletes
- The findings emphasize the importance of a complete evaluation of multiple Triad risk factors by clinicians

Energetic Efficiency, Menstrual Irregularity, and Bone Mineral Density in Elite Professional Female Ballet Dancers

Doyle-Lucas, A. , Akers, J. , & Davy, B. (2010). *Journal of Dance Medicine & Science : Official Publication of the International Association for Dance Medicine & Science.*



Purpose:

- To examine differences between resting metabolic rate (RMR) of professional female ballet dancers compared to non-professional females of similar age, weight, body mass index, and FFM.
- To study the link between the Triad and RMR.

Methods:

- Sampled 39 women
- Ages 18-35 yr.
 - 15 Elite Professional Athletes
 - 24 Non-professional Athletes
- Elite dancers - min. 27 hours training per week
- Non-dancers - less than 150 minutes moderate to vigorous exercise per week

Energetic Efficiency, Menstrual Irregularity, and Bone Mineral Density in Elite Professional Female Ballet Dancers



Methods Continued:

- All women completed
 - Health History Questionnaire
 - 4-day Dietary Food Recall
 - Eating Attitude Test
 - Menstrual History Questionnaire

Results:

- No difference between dietary intake
- Professional dancers had:
 - Lower RMR
 - Lower BMD
 - Lower LEA
 - Higher prevalence of amenorrhea/irregular menses

Energetic Efficiency, Menstrual Irregularity, and Bone Mineral Density in Elite Professional Female Ballet Dancers



Limitations:

- Small sample size
- Self-reported measures of
 - Energy intake
 - Energy expenditure
 - Menstrual history

Conclusion:

- Because dancers were matched by fat free mass and age, findings indicate that the low EA of the dancers may be a contributor to their lower than expected RMR.
- Dancers should be educated about proper eating habits at an early age to prevent development of osteoporosis, amenorrhea, and low energy availability

Association Between the Female Athlete Triad and Endothelial Dysfunction in Dancers

Hoch, A. , Papaneck, P. , Szabo, A. , Widlansky, M. , Schimke, J. & Gutterman, D. (2011). *Clinical Journal of Sport Medicine : Official Journal of the Canadian Academy of Sport Medicine.*



Purpose:

- Study the association between the Triad and brachial artery flow-mediated dilation (FMD) among professional female ballet dancers
- FMD can lead to the development of atherosclerosis and coronary heart disease

Methods:

- 22 Female Ballet Dancers
- Ages 18-35 yrs.
- Participants completed
 - 3 day Dietary Food Recall
 - Wore accelerometers for 72 hrs.
 - EDE Questionnaire

Association Between the Female Athlete Triad and Endothelial Dysfunction in Dancers



Methods Continued:

- Menstrual History Questionnaire
- 9 Hormones measured
 - Follicle Stimulating Hormone, Estrogen, Progesterone, etc.
- BMD - measured by dual-energy x-ray absorptiometry
- Cardiovascular status
 - Blood Pressure
 - Electrocardiogram
 - Heart Rate

Results:

- 77% of ballet dancers had LEA
- 32% had elevated EDE-Q scores
- 18% history of amenorrhea
- 27% history of oligomenorrhea

Association Between the Female Athlete Triad and Endothelial Dysfunction in Dancers



Results Continued:

- 23% had low BMD in at least one body location
- 64% had reduced endothelial function

Limitations:

- Small sample size
- Limited diversity of sample population
- VO₂ was not measured for FMD

Conclusion:

- Inverse relationship was observed between Triad symptoms and endothelial function among ballet dancers.

Restoring Normal Menses In the Triad

Arends, J.C., Cheung, M. C., Barrack, M.T., & Nattiv, A. (2012). *International Journal of Sport Nutrition and Exercise Metabolism*, 22, 98-108

Purpose:

A retrospective study to determine menstrual disturbances in female college athletes utilizing nonpharmacologic therapies (increased dietary intake and/or decreased energy expenditure).



Methods:

- Researchers reviewed female athletes' charts over a 5-year period at UCLA (n=373) to identify menstrual disturbances.
- 51 athletes reported to physician/dietitian of menstrual disturbances (oligomenorrhea n = 38 or amenorrhea n = 13).
- Out of the 51 athletes, 12 displayed disordered eating patterns.
- Baseline of dietary intake was recorded and evaluated by a nutrition software program.
- Prescribed to increase dietary intake by 250-350 kcal/day and if necessary decrease energy expenditure.

Restoring Normal Menses in the Triad



Results:

- Over a 5-year period, 9 athletes with amenorrhea or oligomenorrhea reported a return of menses for 3 months or more (amenorrhea = 3 and oligomenorrhea = 6).
- Athletes with return of menstruation had a higher reported weight gain and increased BMI.
- Athletes who increased dietary intake by 250-350 kcal/day were able to gain 0.5 - 1.0 pound per week.
- Participants who gained 5 lbs or more were twice as likely to have return of menses compared to participants who gained less.

Restoring Normal Menses in the Triad

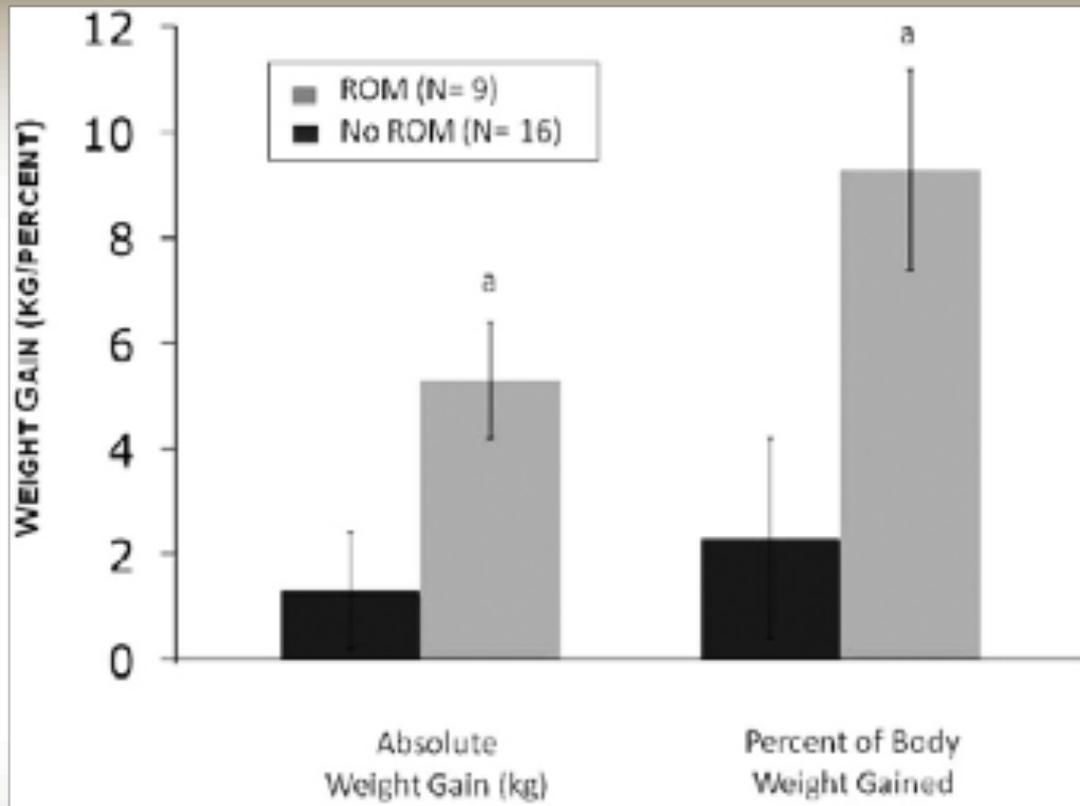
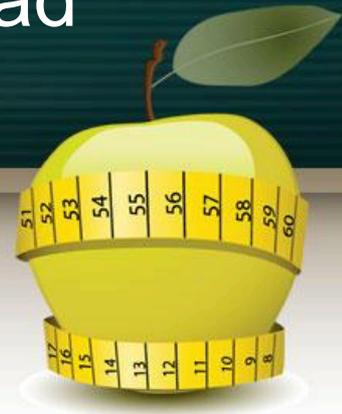


Figure 2 — Weight gain in athletes with return of menses (ROM) compared with those without ROM. ^aSignificant differences between ROM and non-ROM groups, ANOVA $p < .05$.

Restoring Normal Menses in the Triad



Limitations:

- Retrospective study - availability of lab results
- Self-report

Conclusion:

- The first large survey of female college athletes over a 5-year period using nonpharmacologic intervention at a Division I university.
- Further prospective studies needed to explore roles of increasing energy intake, with increase in weight and BMI with return of menses.
- Demonstrates a need for more nutrition education and counseling with college athletes.

Female Athlete Triad Screening in NCAA Division I Athletes

Mencias, T., Noon, M., & Hoch, A. (2012). *Clinical Journal of Sport Medicine : Official Journal of the Canadian Academy of Sport Medicine.*



Purpose:

To determine if NCAA Division I teams are effectively screening for the Female Athlete Triad.

Methods:

- Conducted phone and/or e-mail survey available to all NCAA Division I schools (n=347)
- 257 participated in survey; 287 provided pre-participation evaluation (PPE) forms used (some available publicly on website)
- Compared to items suggested by Female Athlete Triad Coalition - no statistical analysis used (qualitative study)

Female Athlete Triad Screening in NCAA Division I Athletes



Results:

- Many of the questions the Coalition suggests to include regarding disordered eating are not on the majority of PPEs.
- 100% of universities require forms for freshman and transfer students, but not returning student-athletes.
- Only 7% of universities include a nutritional assessment in conjunction with PPEs to assess energy availability.

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