

Session Outline
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"I Expended 1000 kcal – Really?"

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It is not uncommon for manufacturers of exercise equipment to make claims that individuals using their exercise machine can expend considerably more calories than when using another's exercise machine. On a recent cruise I took, the fitness professional associated with the on-board spa claimed that up to 1400 kcal could be expended each hour by doing his one-on-one workout. Most, if not all, of these extreme claims are nonsense. The purpose of this lecture is to help you make correct judgments about such extreme claims, and help clients plan activity programs to meet the energy expenditure goals associated with the health-related benefits of physical activity as described in the *2008 U.S. Physical Activity Guidelines*.

1. How is energy expenditure measured during exercise?

- a. Oxygen uptake measurements
 - i. In the lab and in the field

2. How is oxygen uptake converted to energy expenditure?

- a. One obtains about 5 kcal for each liter of O₂ used: 5 kcal/L O₂
- b. Units describing the rate of energy expenditure
 - i. Kcal/min: 2 L O₂/min x 5 kcal/L O₂ = 10 kcal/min
 - ii. METs: One MET = 3.5 ml·kg⁻¹·min⁻¹ or 1 kcal·kg⁻¹·hr⁻¹
 - 1. 10 METs = 35 ml·kg⁻¹·min⁻¹ or 10 kcal·kg⁻¹·hr⁻¹
- c. Units describing the volume of energy expenditure
 - i. For example, how much energy is expended by a 70 kg person who exercises for 30 min at 10 kcal/min and 10 METs?
 - ii. 30 min x 10 kcal/min = 300 kcal.
 - iii. 10 METs = 10 kcal·kg⁻¹·hr⁻¹ x 70 kg = 700 kcal/hr or 350 kcal/30 min

3. What effect does body weight have on energy expenditure during an exercise in which body weight is carried along?

Gross Cost of Walking One Mile (kcal) at 3 mph						
Weight	110 lb	130 lb	150 lb	170 lb	190 lb	210 lb
kcal	54	64	74	84	94	104

4. How is VO_{2max} linked to energy expenditure during exercise

Percentile Values for VO_{2max} (METs— $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1}$)

Age	20-29		30-39		40-49		50-59		60-69	
Percentile	M	W	M	W	M	W	M	W	M	W
90	15.4	13.7	15.1	12.9	14.6	12.0	13.4	10.8	12.3	10.0
70	13.7	11.7	13.4	11.1	12.6	10.6	11.7	9.4	10.6	8.6
50	12.6	10.6	12.0	10.0	11.4	9.4	10.6	8.6	9.3	8.0
40	12.0	10.3	11.7	9.7	10.9	9.1	10.0	8.3	8.9	7.7
20	10.9	9.1	10.6	8.6	10.0	8.0	8.9	7.4	7.7	6.9

From: ACSM Guidelines. Original Data from Cooper Institute, Dallas, TX.

Remember: We don't exercise at 100% of VO_{2max}

5. What is a reasonable level of energy expenditure for a 30-minute workout at 70% VO_{2max} for people who differ in body size and level of aerobic fitness (VO_{2max})?

VO_{2max} (METs) $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1}$	70% VO_{2max} $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1}$	50kg/110 lb	70 kg/154 lbs	90 kg/198 lbs
16	11.2	280	392	504
14	9.8	245	343	441
12	8.4	210	294	378
10	7.0	175	245	315
8	5.6	140	196	252

6. How do you troubleshoot advertised claims?

- a. Are the claims "too good to be true?" David Swain suggests the following steps:
 - i. Any research on this question (equipment)?
 - a. Do a quick literature search.
 - ii. Consult good references: *ACSM Guidelines*, textbooks, etc.
 - iii. Use your knowledge of exercise physiology
 - b. Example #1: Cruise ship: 1400 kcal/hr? 700 kcal in 30 minutes
 - i. $1400 \text{ kcal/hr} = 20 \text{ kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1}$ for 70 kg person
 - ii. Exceeds VO_{2max} of vast majority of people (see table under #4).
 - c. Example #2: Bowflex TreadClimber
 - i. "Use twice as many calories as a treadmill at the same speed"
 - ii. How could you adjust the treadmill's workload with the speed held constant?

*See David Swain's article (*ACSM's Health & Fitness Journal*. 13(5):8-11, 2009)

7. How does energy expenditure compare across pieces of exercise equipment?

a. More similar than different when workload is set at the same percent of VO_{2max} and when using similar muscle groups.

8. Is the energy cost of walking and running (jogging) a mile the same?

a. No. In spite of an abundance of data to the contrary, it is a common claim.

b. What is the net O_2 cost of moving 1 m/min while walking and running

i. ACSM equations: walk = $0.1 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$ and run = $0.2 \text{ ml}\cdot\text{kg}^{-1}\cdot\text{min}^{-1}$

9. What is the basis for the U.S. Physical Activity Guidelines' recommendations?

a. U.S. Physical Activity Guidelines: 150-300 min/wk of moderate-intensity exercise or 75-150 min/wk of vigorous exercise is based on research showing that 500-1000 MET-min/wk of physical activity results in substantial health benefits.

i. Moderate Intensity: $4 \text{ METs} \times 30 \text{ min} = 120 \text{ MET}\cdot\text{min}/\text{day} \times 5 \text{ days}/\text{wk} = 600 \text{ MET}\cdot\text{min}/\text{wk}$

ii. Vigorous intensity: $8 \text{ METs} \times 30 \text{ min} = 240 \text{ MET}\cdot\text{min} \times 3 \text{ days}/\text{wk} = 720 \text{ MET}\cdot\text{min}/\text{wk}$

10. How does one use the Compendium of Physical Activity?

(<http://sites.google.com/site/compendiumofphysicalactivities/home>)

a. Find the activity of interest and record the MET value and express in $\text{kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1}$.

i. For example: A 55 kg woman bicycles to and from work (60 minutes round trip) and wants to know how much energy she has expended.

a. Compendium: Bicycling to and from work = $6.8 \text{ kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1}$

i. $6.8 \text{ kcal}\cdot\text{kg}^{-1}\cdot\text{hr}^{-1} \times 55 \text{ kg} = 374 \text{ kcal}/\text{hr}$

11. What should the focus of the exercise prescription be from a health-benefit standpoint?

a. The answer is, "The client in front of you!"

i. Suit the intensity recommendation to the client

a. Consider age, fitness, exercise background, goals, etc.

ii. Progression is key

a. Gradually increase the duration/frequency and then intensity to achieve an energy expenditure of 500 to 1000 MET-min/wk.

Take away messages:

1. If something is "too good to be true," it probably is. Check it and out and educate yourself and your client.

2. Estimates of energy expenditure are easily calculated using the Compendium of Physical Activity to help clients meets health and fitness goals

a. Each client should know how many kcal he/she needs to expend each week to obtain the health-related benefits of physical activity, and how to meet that goal.