

Lab #2

Caloric Cost and Fuel Utilization

1 Mile Walk vs. 1 Mile Run

Student Learning Objectives

After completing this lab, you should be able to:

1. Define, explain and correctly use key terms.
2. Explain how oxygen consumption (VO_2), respiratory exchange ratio (RER), and energy expenditure are related
3. Calculate the caloric cost of walking and running the same distance
4. Explain the interaction between intensity and duration on energy expenditure and fuel utilization

Equipment

- Motor Driven Treadmill
- Metabolic Cart (i.e. O_2 & CO_2 Analyzers)
- Noseclip and Mouthpiece

Procedure

The relationship between VO_2 , RER and energy expenditure will be examined by comparing the caloric cost of walking and running the same distance. One student whose fitness level will permit walking a mile in 15-20 minutes ($4.8\text{-}6.4 \text{ km}\cdot\text{hr}^{-1}$; 3.0 to $4.0 \text{ mi}\cdot\text{hr}^{-1}$), resting for 5 minutes and then running a mile in 7-10 minutes ($9.7\text{-}13.8 \text{ km}\cdot\text{hr}^{-1}$; 6.0 to $8.5 \text{ mi}\cdot\text{hr}^{-1}$) is selected.

Protocol

1. Stand quietly for 3 minutes. When gas analysis data indicates relaxation and a true resting state, 3 minutes of resting data are obtained. Gas analysis is continuous from that point.
2. Walk 1 mile at 0% grade at a self-selected pace within the guidelines specified.
3. Sit and rest for 5 minutes.
4. Run 1 mile at 0% grade at a self-selected pace within the guidelines specified.
5. Cool down by walking for 3 minutes.
6. VO_2 and RER are measured and recorded as indicated in the data table.

Name: _____ Age (yr): _____ Temp (°C): _____
 Training Status: _____ Ht (cm): _____
 Sex: _____ P_B(mmHg): _____ Wt (kg): _____ RH (%) _____

Speed (km•hr ⁻¹ /mi•hr ⁻¹)	Exercise Time (minutes)	VO ₂ (L•min ⁻¹)	RER	Caloric Equivalent (kcal•L O ₂ ⁻¹)	Calories (kcal•min ⁻¹)	% Kcal	
						% CHO	%FAT
Rest	1						
	2						
	3						
1 Mile Walk	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
18							
19							
20							
Mean							

Total Caloric Expenditure for Walk (kcal): _____ (Do not include resting minutes)
 Mean VO₂ (mL•kg•min⁻¹):* _____
 Average Caloric Expenditure for Rest (kcal•min⁻¹): _____

* Note to Student: Convert mean VO₂ L•min⁻¹ to VO₂ mL•min⁻¹ and then divide by body weight.

Speed ($\text{km}\cdot\text{hr}^{-1}/\text{mi}\cdot\text{hr}^{-1}$)	Exercise Time (minutes)	VO ₂ ($\text{L}\cdot\text{min}^{-1}$)	RER	Caloric Equivalent ($\text{kcal}\cdot\text{L O}_2^{-1}$)	Calories ($\text{kcal}\cdot\text{min}^{-1}$)	% Kcal	
						%CHO	%FAT
1 Mile Jog	1						
	2						
	3						
	4						
	5						
	6						
	7						
	8						
	9						
	10						
	11						
	12						
	13						
	14						
	15						
	16						
	17						
	18						
	19						
	20						
Mean							
	Total Caloric Expenditure for Jog (kcal): _____ (Do not include resting minutes)						
	Mean VO ₂ ($\text{mL}\cdot\text{kg}\cdot\text{min}^{-1}$):* _____						
	* <i>Note to Student: Convert mean VO₂ $\text{L}\cdot\text{min}^{-1}$ to VO₂ $\text{mL}\cdot\text{min}^{-1}$ and then divide by body weight.</i>						

RER Table (use to determine Kcal · min⁻¹)

Nonprotein RER	Kcal per Liter O ₂ Uptake	% Kcal Derived from		Grams Per Liter O ₂ Uptake	
		CHO	Fat	CHO	Fat
0.707	4.686	0	100	0	0.496
0.71	4.69	1.1	98.9	0.012	0.491
0.72	4.702	4.8	95.2	0.051	0.476
0.73	4.714	8.4	91.6	0.9	0.46
0.74	4.727	12	88	0.13	0.444
0.75	4.739	15.6	84.14	0.17	0.428
0.76	4.75	19.2	80.8	0.211	0.412
0.77	4.764	22.8	77.2	0.25	0.396
0.78	4.776	26.3	73.7	0.29	0.38
0.79	4.788	29.9	70.1	0.33	0.363
0.8	4.801	33.4	66.6	0.371	0.347
0.81	4.813	36.9	63.1	0.413	0.33
0.82	4.825	40.3	59.7	0.454	0.313
0.83	4.838	43.8	56.2	0.496	0.297
0.84	4.85	47.2	52.8	0.537	0.28
0.85	4.862	50.7	49.3	0.579	0.263
0.86	4.875	54.1	45.9	0.621	0.247
0.87	4.887	57.5	42.5	0.663	0.23
0.88	4.887	60.8	39.2	0.705	0.213
0.89	4.924	64.2	35.8	0.749	0.195
0.9	4.936	67.5	32.5	0.791	0.178
0.91	4.936	70.8	29.2	0.834	0.16
0.92	4.948	74.1	25.9	0.877	0.143
0.93	4.961	77.4	22.6	0.921	0.125
0.94	4.973	80.7	19.3	0.964	0.108
0.95	4.985	84	16	1.008	0.09
0.96	4.998	87.2	12.8	1.052	0.072
0.97	5.01	90.4	9.6	1.097	0.054
0.98	5.022	93.6	6.4	1.142	0.036
0.99	5.035	96.8	3.2	1.186	0.018
1	5.047	100	0	1.231	0

Student Activities

A. Analysis

1. Complete data Table 1.0 using a table of caloric equivalents. Calculate both the rate of expenditure ($\text{kcal} \cdot \text{min}^{-1}$) and total expenditure (kcal) for *a*) walking 1-mile and *b*) running 1-mile.
2. Determine the % CHO and % FAT utilized during the 1-mile of walking and 1-mile of running using the average RER value for each mile.
3. Calculate the MET level for walking and running 1-mile.
4. Graph the Total Energy Expenditure (kcal) obtained from the ParvoMedics Metabolic Cart and compare it to the calculate method. (be sure to show both 1-mile walk and 1-mile jog).

B. Interpretation and Discussion

1. Compare and contrast the energy expenditure in kcals and METS for walking and running 1-mile.
2. Compare and contrast the fuel utilization between walking and running 1-mile.

C. Application

1. Defend or Refute: The only way to lose body fat is to burn body fat as a fuel.
2. Defend or Refute: Long duration, low intensity exercise is better than moderate duration, moderate to high intensity exercise for weight control.
3. Would you expect these results to be similar or different if a child/adolescent was the subject? That is, are children/adolescents as economical as adults? What practical significance does this have when children/adolescents run or walk with an adult?