

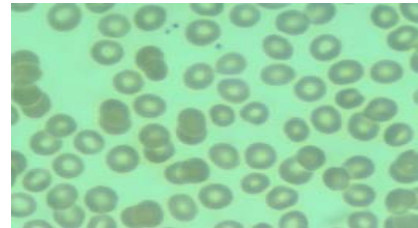
# Energy & Metabolism: Practical Applications 122

Carla Botelho Sottovia, PhD

***INSPIRE THE WORLD TO FITNESS***

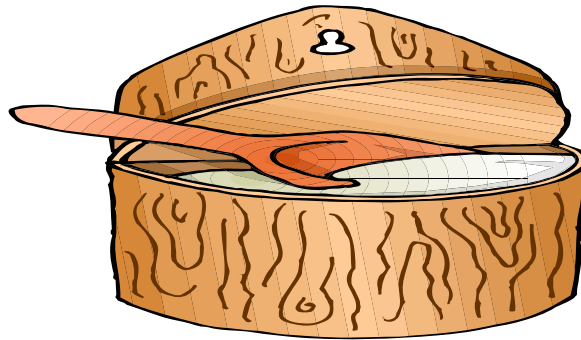
# Energy Subsystem = Glucose/ FFA

- Normal Blood conc. = 70-100 mg.dl
- Hormonal Regulation= Insulin x Glucagon
- **Insulin**= moves glucose from the blood into the cells – energy
- **Glucagon** = glucose out storage when in need ( liver).



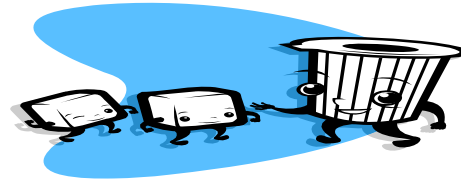
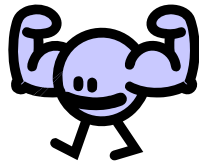
# Energy Subsystem = Glucose/ FFA

- Liver + Muscle= store glucose as “Glycogen” (energy needs for 12 to 24hrs).
- **Extra “glucose” converted by liver into fat and is stored in the fat cells.**



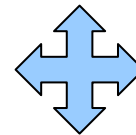
# Energy Subsystem = Glucose/ FFA

- If CHO are in short supply = insulin secretion is decreased by the pancreas / increase in enzyme Lipase ( release of FFA ) = FFA used for energy with exception of the brain.
- **Brain Glucose Supply** = breakdown of body proteins to produce Glucose.



# Energy Subsystem = Protein/ AA

- **AA** = major building blocks for the synthesis of body tissue.
- **Daily protein loss** = 20 -30 gr. to produce other body chemicals.
- **Cells** = must form new proteins.
- To prevent net loss of protein = Protein intake from diet.
- **Excess Protein** = stored as fat/ glucose.



# Fate of AAs

**Dietary Protein**

**Digestion = release of AAs**

23%

**Blood stream**

Plasma proteins

Hormones

Tissue protein

Tissue Anabolism

Liver = AA uptake  
20%

NH<sub>3</sub> output

**Tissue Catabolism**

**Fecal NH<sub>3</sub>**  
10%

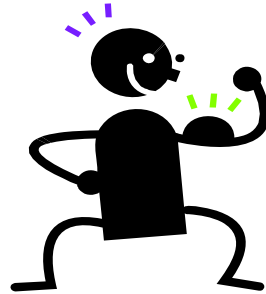
Amino (kidney) =  
urea/amonia/AA

Carbon Skel. =

Ketones  
Glucose  
FAs

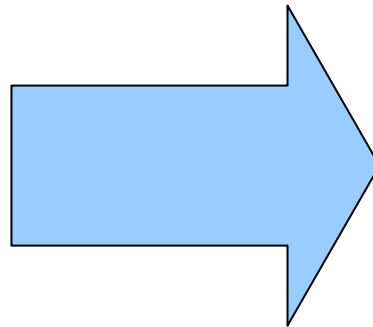
# CHO & FAT use during Exercise??

- Availability
- Intensity
- Duration
- CV Fitness Level

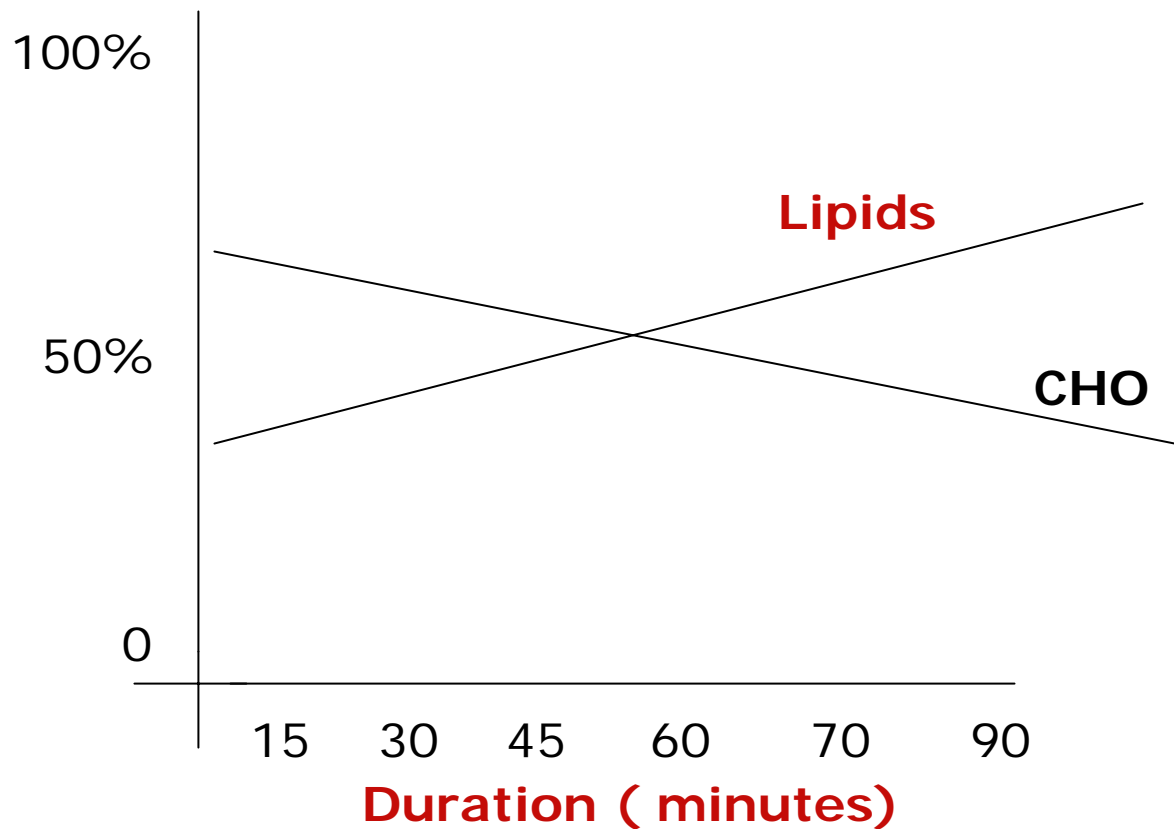


# Availability

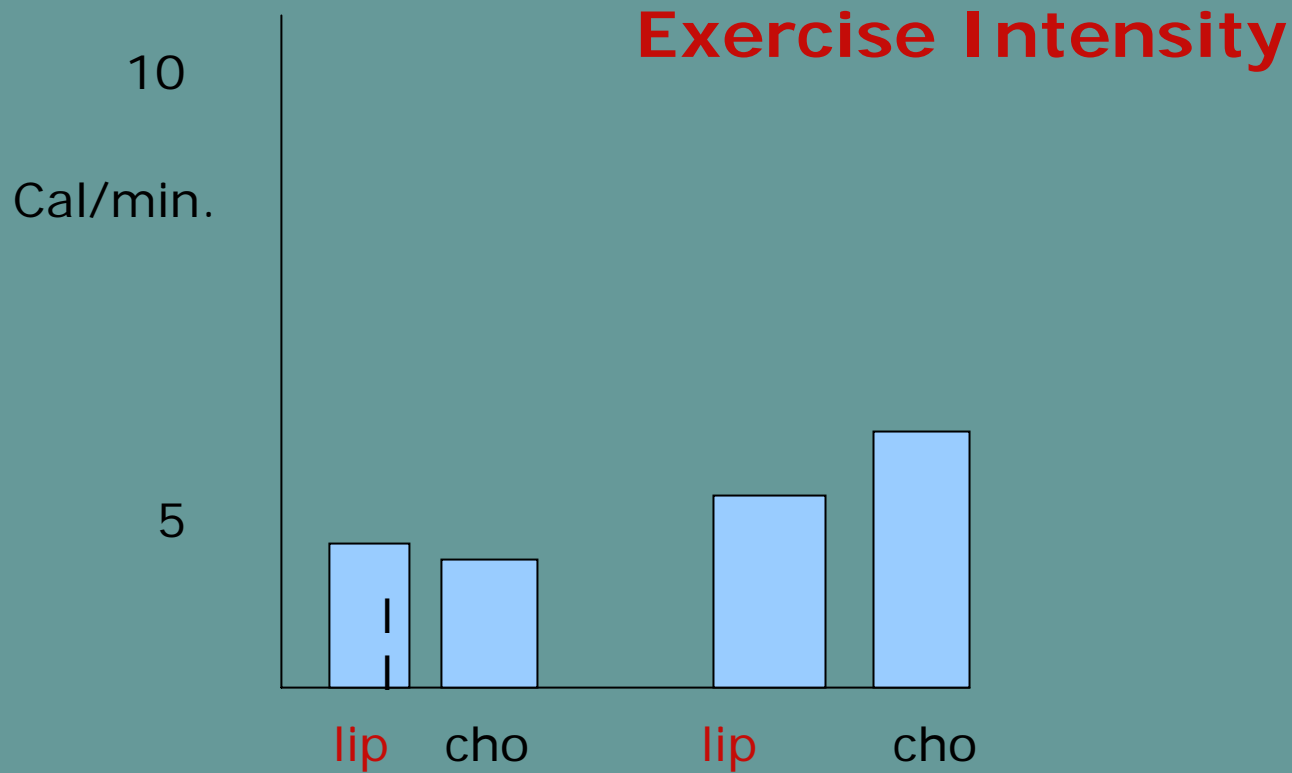
- **Initially** = CHO(s) are the main source of energy.
- **As Exercise Duration increases** = FFA oxidation.



# FAT & CHO Use during Activity



# ● CHO & FAT OXIDATION



Baixa Intensidade: 30  
to 50% Vo2Max

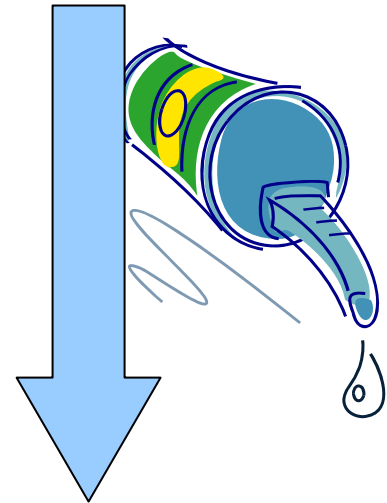
Intensidade  
Moderada: 51 to  
75% of Vo2Max

# Exercise Intensity & Fat Oxidation

- **30 to 70 % of Vo2Max**
- I.e.,: Achten and co-workers ( 2002): **51% to 76% of Vo2Max.**
- **Limited Fat Oxidation:** > 85% of Vo2Max.

# Exercise Intensity & Fat Oxidation

- **CrossOver Concept**
- Power output(  $> 75\%$  of  $Vo_{2Max}$ ) at which energy from CHO predominates over energy from Lipids (Brooks & Mercier, 1994).



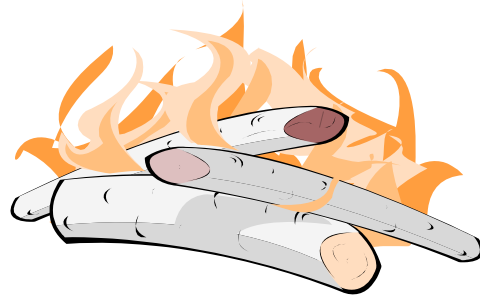
# Gender

- **Females-** Submaximal Exercise: Greater Fat Oxidation.
- **Estrogen:** Increase Lipolysis ( FFAs).
- **Progesterone:** May decrease the rate of glucose production which in turn may enhance the effects of Estrogen on fat mobilization.



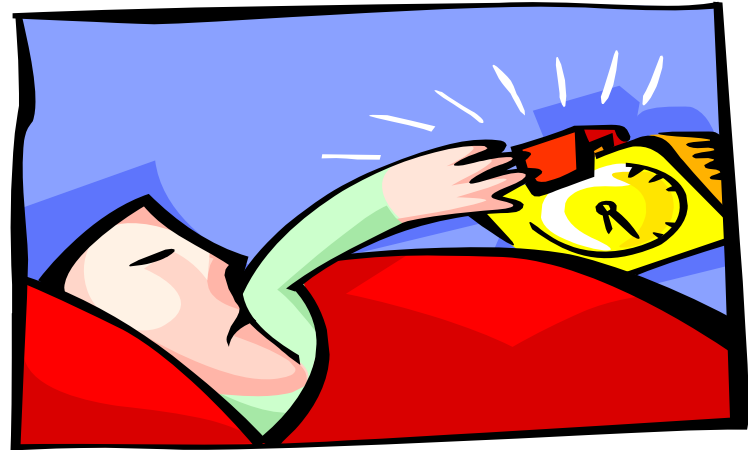
# Metabolism

- **Burning of Calories** necessary to supply the body with the energy it needs to function.
- **???How do we burn calories during the day???**



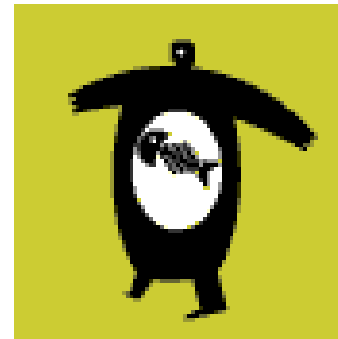
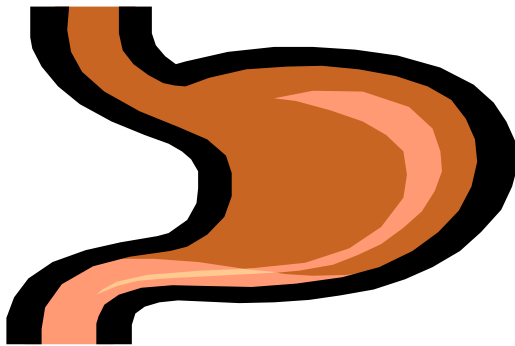
# Basal Metabolic Rate & Resting Metabolic Rate

- **BMR:** Minimum level of energy required to sustain the body's vital functions in the waking state. Measured by O<sub>2</sub> consumption – fasting 12 hrs. **Slightly lower than RMR.**



# Basal Metabolic Rate & Resting Metabolic Rate

- **\*\*RMR:** may take into account energy required for digestion, absorption- O<sub>2</sub> consumption 3- 4 hrs after meal. **It may account for 65-75% of one's total daily calorie expenditure.**



# BMR X RMR

- BMR: 1kcal/min in **women** ( 1,150 to 1,440 kcal/day).

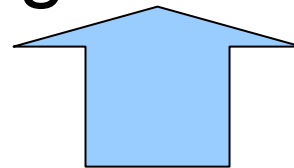
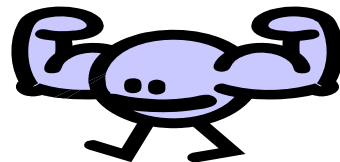


- **Men:** >1 kcal/min (1,580 to 1,870 kcal/day).



- **RMR values:** about 10 to 20 % higher than BMR.

- Greater the **FFM** >> greater **RMR**



# Thermic Effect of Food- TEF

- Energy expended to digest, absorb and store food that we eat. It accounts for about **5 -10 %** of the total calories burn in a day.

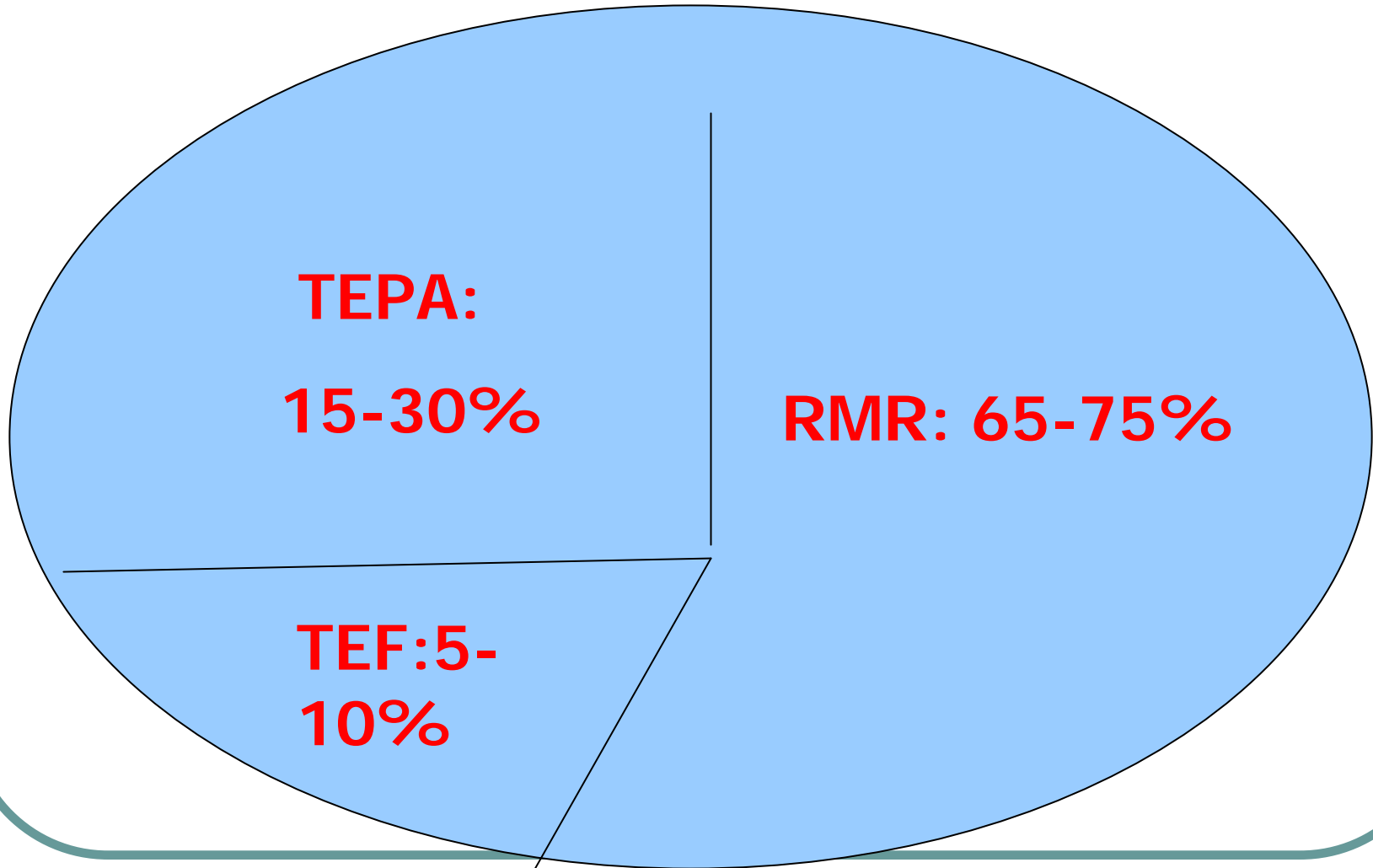


# Physical Activity Energy Expenditure- PAEE

- Exercise
- Activities of Daily Living
- **15-30%** of your total calories burn per day.



# Components of Energy Expenditure



???????

- How much does my RMR increase post exercise??
- Is it significant??
- Is there a difference in Resting Metabolic Rate between Trained and Untrained indiv.?
- Cardiovascular x Strength Training??

# RMR x Post Exercise

- **Very Little Increase.**
- Depending on the intensity of the activity, one may burn anywhere from **10 to 30 extra calories.**
- Exercise Intensity: **50% or > Vo2Max.**
- **Temporary Adaptation.**

# Trained x Untrained

- Very little differences at **Rest**.
- Post Activity: **RMR greater only when exercise intensity > 70% of Vo2MAX.**

# Cardiovascular x Strength Training

- **Not greatly increased** to account for the so claimed “**Increased Metabolism**”.
- **Fact: 1lb muscle = RMR ( 7 to 10 kcal/day).**
- Most individuals may gain **4 to 5 lbs of FFM per year.**



# Cardiovascular x Strength Training

- Melanson, et.al (2002) – MSSE.
- Compare **24hr energy expend(EE):**  
Cycle x Resistance Trng.
- Subjects: 10 males.
- Protocol: **BK** ( 50 min at 70%  
Vo2max)/**Circuit trng** ( 70 min/  
70%1RM).4 sets/10exerc.
- Kcals: **BK( 546 kcal)/ Resist. 448kcal).**

# Results

- **During Exercise- EE:** Bike (11.5 kcal/min x 6.05 kcal Resist).



# Results



- **Post-Exercise EE (30min)**. 2.5kcal.min (B)-**extra 75kcal** x 1.59 kcal (R)- **extra 48 kcal**. Back to resting normal values for the rest of the day.

# Results

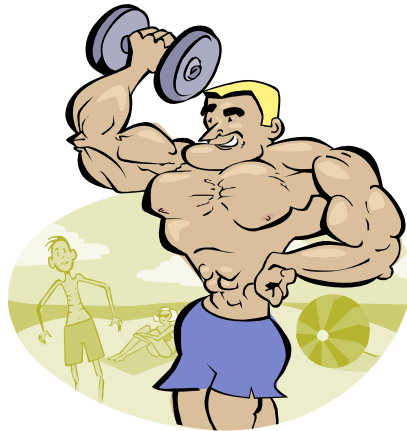
- **RER-24hr**: similar on B x W ( 0.89 x 0.88).
- **RER 30 min post**: same ( 0.86 x 0.83).
- **24 hour**: FAT x PROT. Oxidation no #.
- **24 hour**: CHO oxid: 370 kcal (B) x 349 (R).

# Results

- **Slight greater caloric expenditure** during Bike x Resistance. ( 546 x 448 kcal).
- **Very little increase in EE post exercise** for both activities.(75 X 48 KCAL)
- **Fat and Protein oxidation post= no change and/or difference** between modalities.

# Take Home Message

- Focus on calories expended during the activity.
- Focus on exercise intensity / duration.
- Overall Lean Mass x Fat Mass.



# Physical Activity x Diet x Weighth Loss

- When **caloric expenditure is the same** between treatments (diet/PA) = **weight loss is the same.**



# Physical Activity x Diet x Weight Loss

- Diet Alone = **greater loss of FFM** when compared to PA.



# Physical Activity x Diet x Weight Loss

- PA = enhanced health benefits (i.e., reduction in visceral fat).



# How Much PA??

- **Jakicic, et. Al. 2003 – JAMA**
- **Duration:** 12 mo.
- **Subjects:** 184 obese women.
- **Training Groups:** moderate ( 40 to 60% of Vo2Max) x High ( > 60%)
- **Diet** = 1200 to 1500 kcal/day.
- **Exercise Duration**= > 150 min x 150 to 200 min per week.

# Results

- 150 min or > of activity = **7.0 kg ( 15.4 lbs) to 6.3 (14 lbs)** ( high/moderate intensity).
- 200 min or > of activity = **8.9 (20lbs) kg to 8.2 kg (18lbs)(high/moderate intensity).**

# Take Home Message

- Focus on duration of activity ( at least **30 to 40 minutes session**) at moderate intensity ( **60% or >**). Total Minutes per Week ( **200 min or more per week**).



# Summary

- **Fat Oxidation**: 50 to 70 % of  $Vo_2Max$ .
- **CHO Oxidation**: 75% of  $Vo_2Max$ .
- **RMR**: focus on calories expended during the activity ( intensity & duration).
- **Total minutes of activity per week** (>200 min.).
- **Balanced** Caloric Intake.



# Contact

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