



# *ALI 481: Impact of Fasting on Healthy Subjects*

# **Disclaimer**

- **The nature of this talk is only presenting some evidences of physiologic & metabolic impact of fasting on healthy subject**
- **Does not substitute for medical advice**
- **Please consult your family physician/  
Specialist**

# **Holy Month of Ramadan**

- **Ramadan is a month of self-regulation, self-training & discipline**
- **Fasting fosters a strong will,**
  - **teaches patience, & self-discipline**
  - **The ability to bear hardship & tolerate hunger/thirst**
- **It regulates & systematizes the energies of instincts**

# **Health is the key to happiness**

- **What we consume directly affects our health**
- **Islam encourages Muslims to be very mindful of their health**
- **Prophet (SA): “Take advantage of the good health before illnesses afflict you”**
- **He also encouraged Muslims to try their best to take up a healthy living lifestyle**
  - **A balanced diet, regular mental & physical exercise**
  - **A balance between material & spiritual needs**

**The general belief:**

**Eating & Nutrition = Health**

**But Prophet Muhammad (S):**

**«صُومُوا تَصِحُّوْا»**

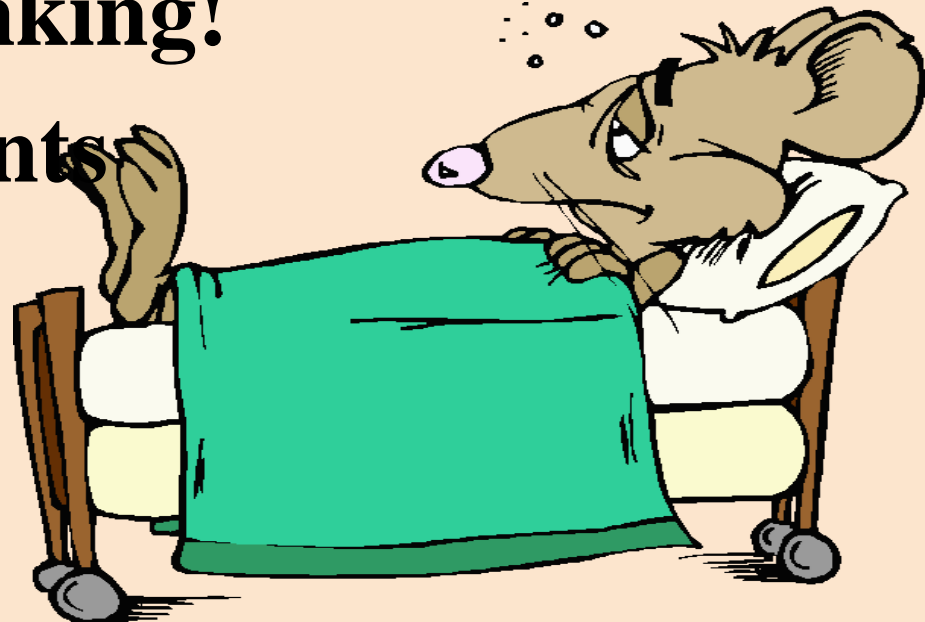
**(Sumoo Tasihhoo)**

***“Fast to become healthy”***

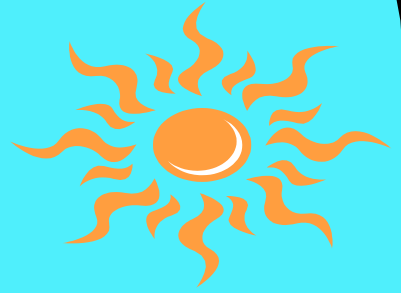
***“Fast & Flourish.”***

# Fasting & Health

- When any animal get sick?
  - Stop eating & drinking!
- Feeding stroke patients
  - Worse!



# Our Ancestor



Had limited access to food & water with periods of fasting

- This would allow; using stored energy & fat mobilization,
- Lipolysis, and ketogenesis
- Opposite to:





# **Fasting: From Scientific point?!**

- **Intermittent daylight fasting;  
omitting one meal when the body is  
particularly metabolically active**

# Self Discipline & Behaviour Therapy

The dietary discipline that we learn in Ramadan is a great form of behaviour therapy, and is a beneficial thing to carry over into our regular lifestyle.

**Dietary discipline: When do you eat?**

**Do you eat when you're hungry or when you're bored?**

**Do you eat on the go, or do you take your time?**



# **Take home messages:**

- **We have been designed in nature with periods of access to nutrient and periods of fasting?!**
- **Naturally in case of sickness: stop eating and drinking**
- **In addition to spiritual effect;**
  - **Can Fasting have physiologic/metabolic benefit too?**

# Water Homeostasis during fasting

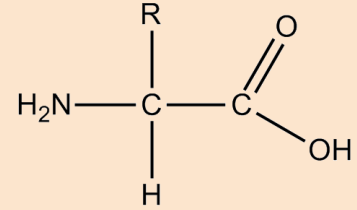
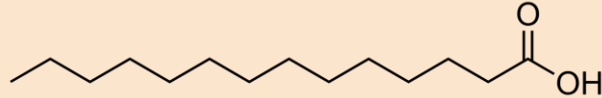
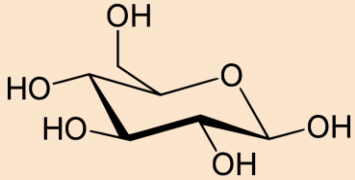
- Why do we need H<sub>2</sub>O?
- For heat loss
  - From work
  - Metabolism



# **Water Homeostasis during fasting**

- ↓ Eating ↓ Heat production ↓ need for H<sub>2</sub>O**
- If we avoid heavy physical activity**
- 5/6 of heat loss can be directly through the skin**
- No detrimental effects on health have as yet been directly attributed to negative water balance**

# Sources of energy in the Body



**Carbohydrates** (Glucose acids)



**Lipids** (Fatty acids)



**Protein** (amino acids)

# Does fasting cause dietary deficiency?

- ↑↑ total energy/nutrient intake
- ↑ Consumption of fruits & vegetables
- Iftari was important contributor to calories 65%, lipids 74%, proteins 71% & Carbohydrates 56%
- → Improved nutritional status because of eating behavior; denser meal, higher quality meals
- Overall No change in body weight or minimal wt gain

**Eastern Mediterranean Health Journal, J**  
**Food intake during and outside Ramadan**  
**Gharbi M, Akrouf M, Zouari B.** Tunis, Tu

J Res Med Sci. 2014 Oct;19(10):987-92.

**Is Ramadan fasting related to health outcomes?**  
**A review on the related evidence.**

Rouhani MH1, Azadbakht L1.

# **Take home messages:**

- We need H<sub>2</sub>O mainly for sweat to lose heat!**
- Simultaneous No Food intake reduces heat generation**
- Avoid heavy work /exercises during fasting**
- Mild - H<sub>2</sub>O balance has no detrimental effect**
- Overall nutritional status improves**



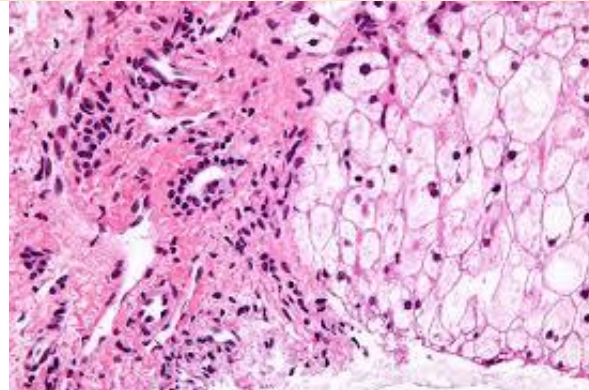
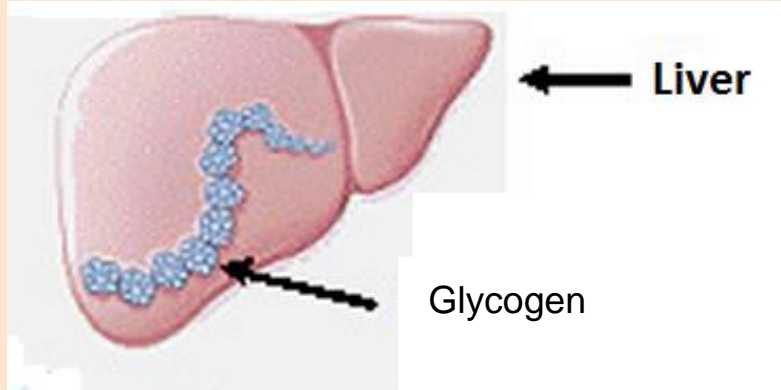
# What happens after Feeding?

- Following ingestion of carbohydrates and amino acids, insulin is secreted.
- This allows glucose uptake by muscle to be used directly for energy (Brain does not need Insulin)
- Excess glucose
  - is stored as glycogen in the liver
  - excess elements of fat is stored



# The Post Absorptive Phase

- 6-24 hours after beginning fasting.
- Insulin levels start to fall.
- **Glycogenolysis: the breakdown of glycogen to release glucose for energy.**



irs

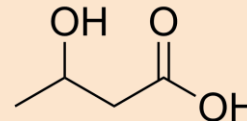
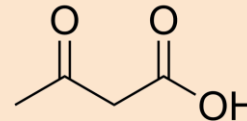
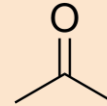
# Alternative fuel sources during fasting

## Gluconeogenesis

- The brain primarily uses glucose as its fuel (Ketones are brain favorite fuel)
- So, the liver needs to manufacture glucose from other intermediates in the body in a process called “gluconeogenesis”.

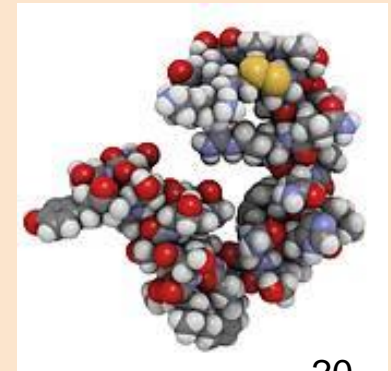
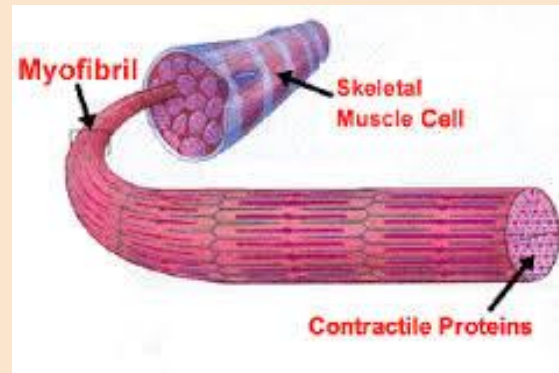
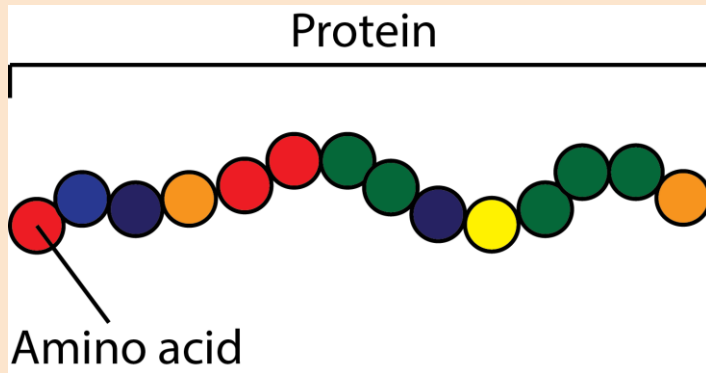
## Ketogenesis

- After 14-16 h of fasting, the liver begins to make ketone bodies from fatty acids
- After 4 days of fasting, ~ 75% of the energy used by the brain is provided by ketones.



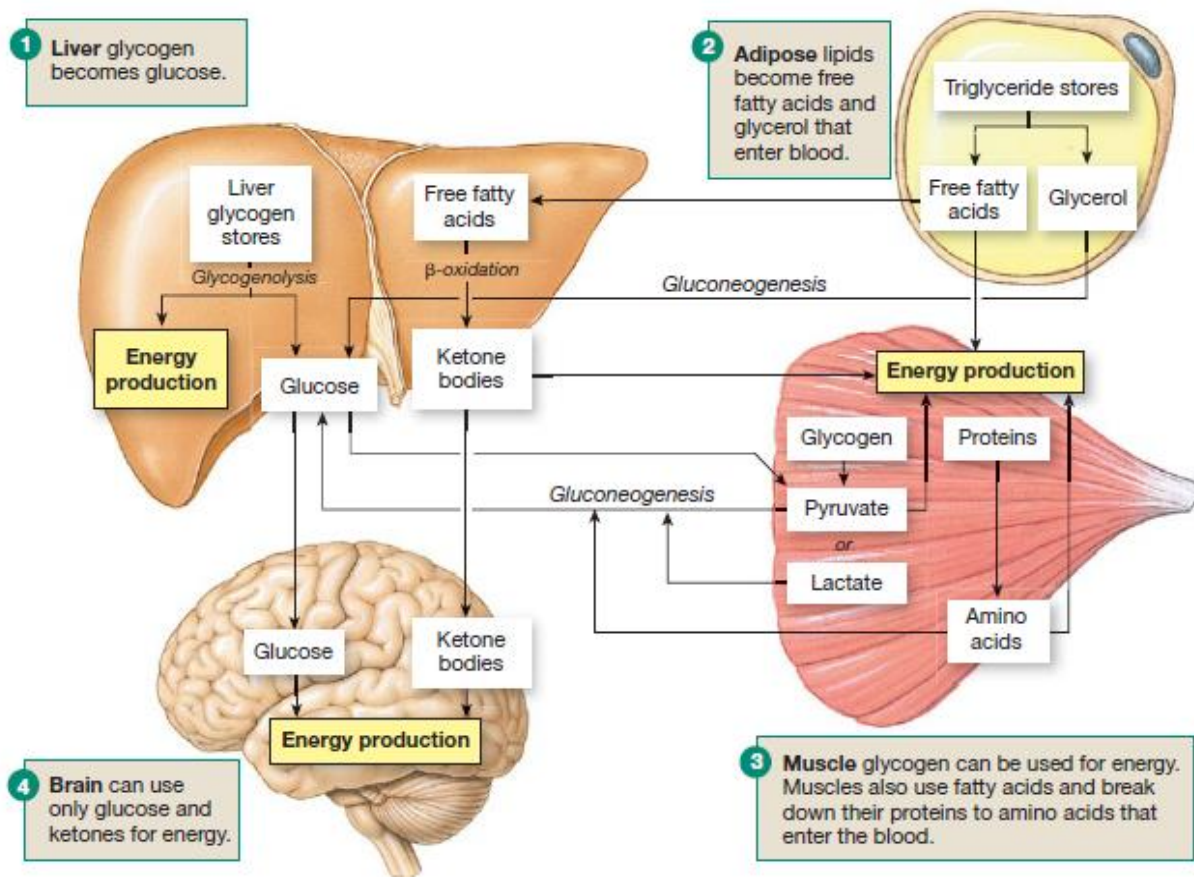
# Protein Breakdown Phase

- This is NOT what we want
- Happens usually after 18-24 hours after fasting, when all accessible sources of fats are used up
- Body breaks down the protein in muscles into amino acids.
- Amino acids are then used in the process of gluconeogenesis.



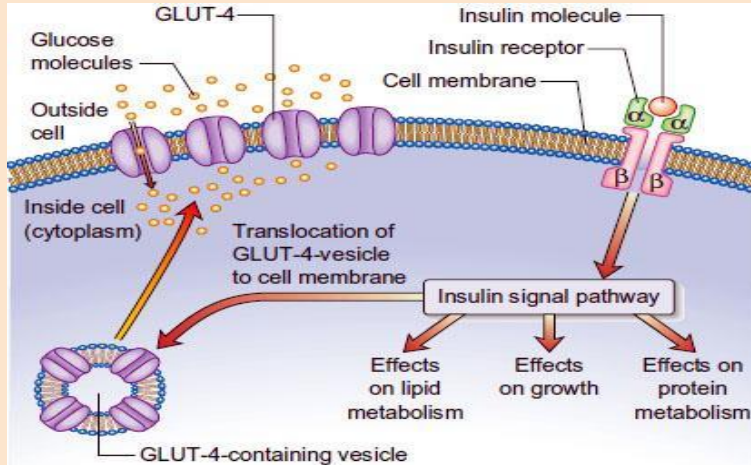
# In Summary

Fasted-state metabolism must maintain plasma glucose homeostasis for the brain.

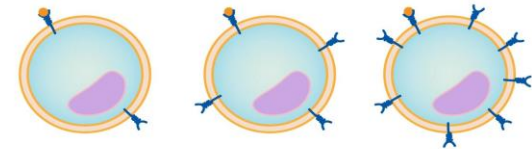


# Insulin and Diabetes

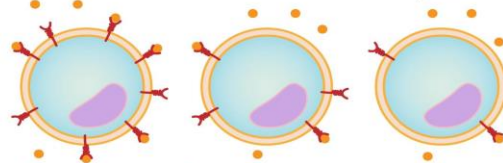
- Regular fasting, in addition to lowering insulin levels, it improves insulin sensitivity significantly
- Persistent & Excess levels of insulin make cells less responsive to insulin
- Fasting makes cells more “insulin sensitive”.



## upregulation



time →



## downregulation

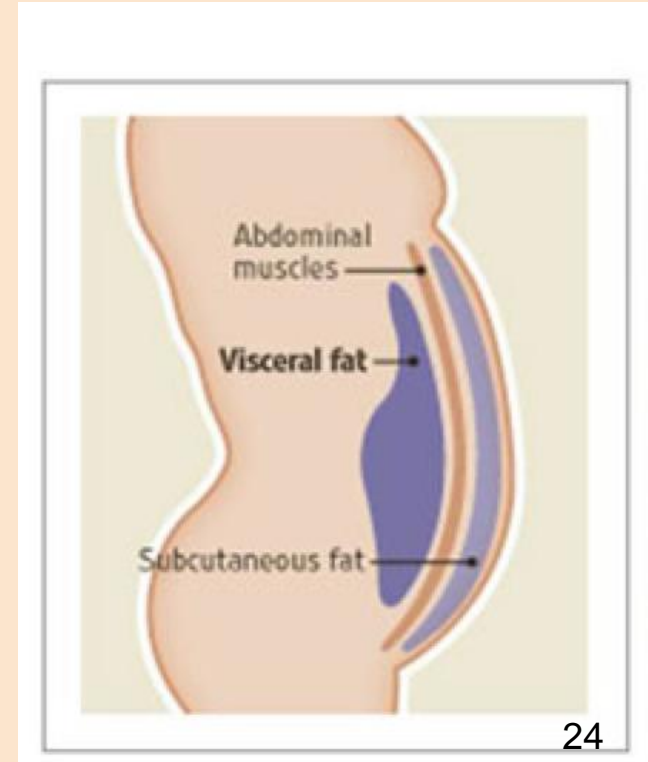
# **Take Home Message**

- **Many hours of low insulin concentration during fasting will increase insulin sensitivity**
- **Healthy diet during Iftar and Suhoor rich in complex carbohydrate, protein and saturated fat prevents significant hyperinsulinemia**
- **Continue to watch your weight and do some gentle aerobic exercise**
- **Reduction in visceral fat, will reduce insulin resistance**



# Subcutaneous Vs. Visceral Fat

- Subcutaneous fat is located under the skin of arms, legs and buttocks.
- It acts as padding, in energy reservation, as well as insulation.





# Visceral fat

- Visceral fat is body fat that is stored within the abdominal cavity and around heart (epicardial fat).
- Visceral fat is sometimes referred to as 'active fat' because research has shown that this type of fat plays a distinctive and potentially dangerous role affecting how our hormones function
- Carrying a high amount of visceral fat → insulin resistance
- Heart disease, Breast cancer, Colorectal cancer, and Alzheimer's disease



# Evaluate changes in abdominal fat distribution in Ramadan

- 38 healthy who fasted in Ramadan
- Abdominal fat before and after Ramadan fasting measured using CT
- No significant differences were found in total fat, waist, BMI



There was a significant reduction in

**Tohoku J Exp Med.** 2004 Nov;204(3):179-87.

The effect of fasting month of Ramadan on the abdominal fat distribution: assessment by CT. Yucel A, Afyon, Turkey

# Take Home Message

- Fasting can reduce visceral fat, which
- Correlates with insulin resistance and increased LDL levels.
- Associates with cardiovascular disease, dementia, colorectal cancer.

## Point: Visceral Adiposity Is Causally Related to Insulin Resistance

Harold E. Lebovitz, MD and Mary Ann Banerji, MD, FACP

[PLoS One](#). 2014 Nov 17;9(11):e110587. doi: 10.1371/journal.pone.0110587. eCollection 2014.

## Visceral fat accumulation is associated with colorectal cancer in postmenopausal women.

[Lee JY<sup>1</sup>](#), [Lee HS<sup>2</sup>](#), [Lee DC<sup>1</sup>](#), [Chu SH<sup>3</sup>](#), [Jeon JY<sup>4</sup>](#), [Kim NK<sup>5</sup>](#), [Lee JW<sup>1</sup>](#).

[Lipids Health Dis](#). 2011 Jan 19;10:12. doi: 10.1186/1476-511X-10-12.

## Low density lipoprotein cholesterol is inversely correlated with abdominal visceral fat area: a magnetic resonance imaging study.

[Hoenig MR<sup>1</sup>](#), [Cowin G](#), [Buckley R](#), [McHenry C](#), [Coulthard A](#).

[Cancer Med](#). 2016 Jan;5(1):41-8. doi: 10.1002/cam4.571. Epub 2015 Dec 2.

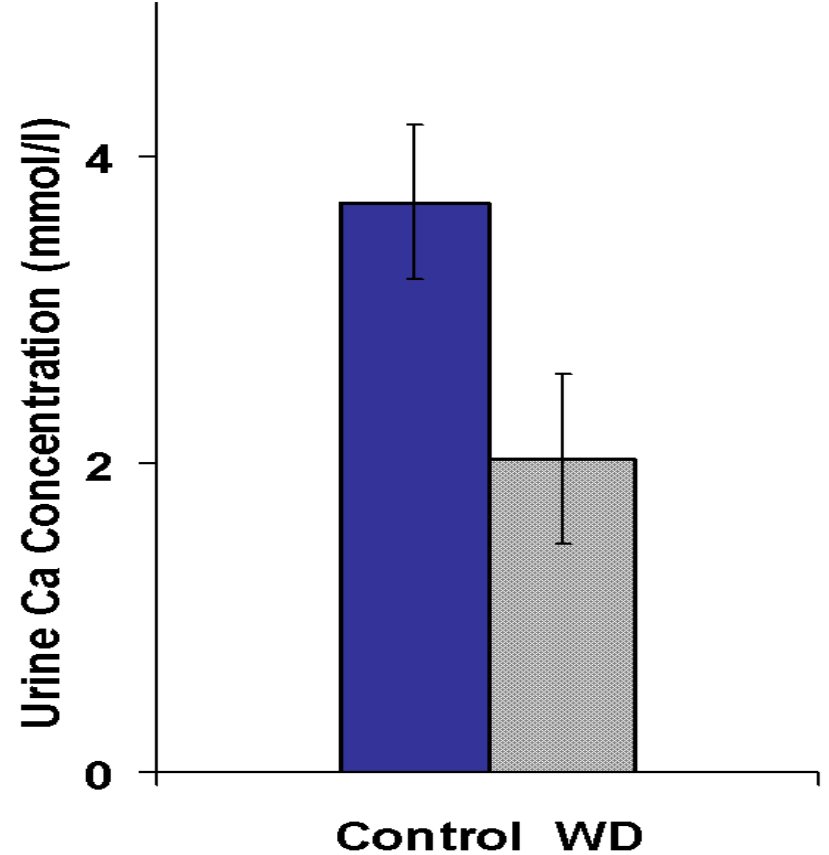
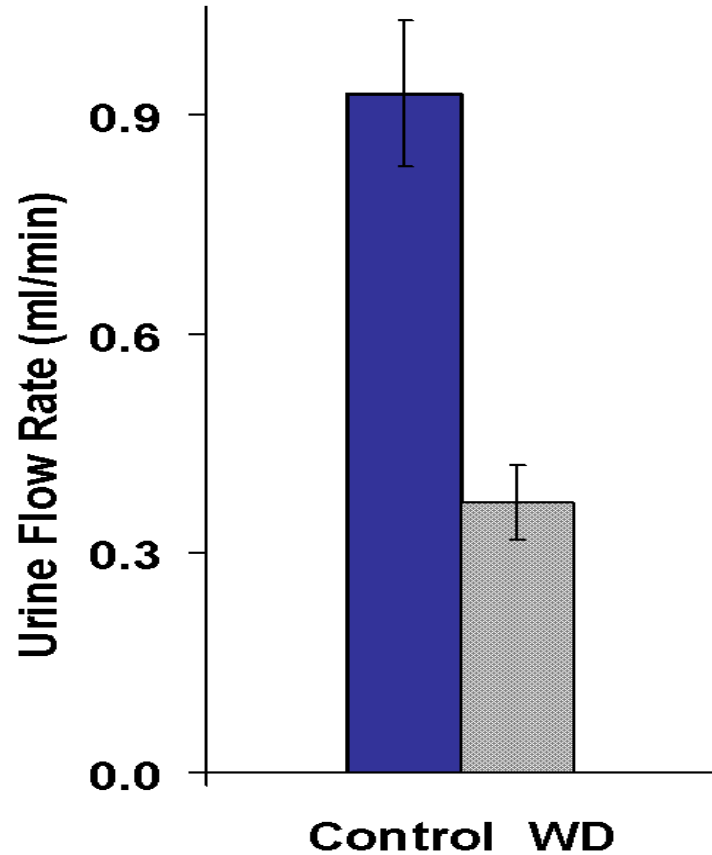
## Impact of body fat distribution on neoadjuvant chemotherapy outcomes in advanced breast cancer patients.

[Iwase T<sup>1</sup>](#), [Sangai T<sup>1</sup>](#), [Nagashima T<sup>1</sup>](#), [Sakakibara M<sup>1</sup>](#), [Sakakibara J<sup>1</sup>](#), [Hayama S<sup>1</sup>](#), [Ishigami E<sup>1</sup>](#), [Masuda T<sup>1</sup>](#), [Miyazaki M<sup>1</sup>](#).

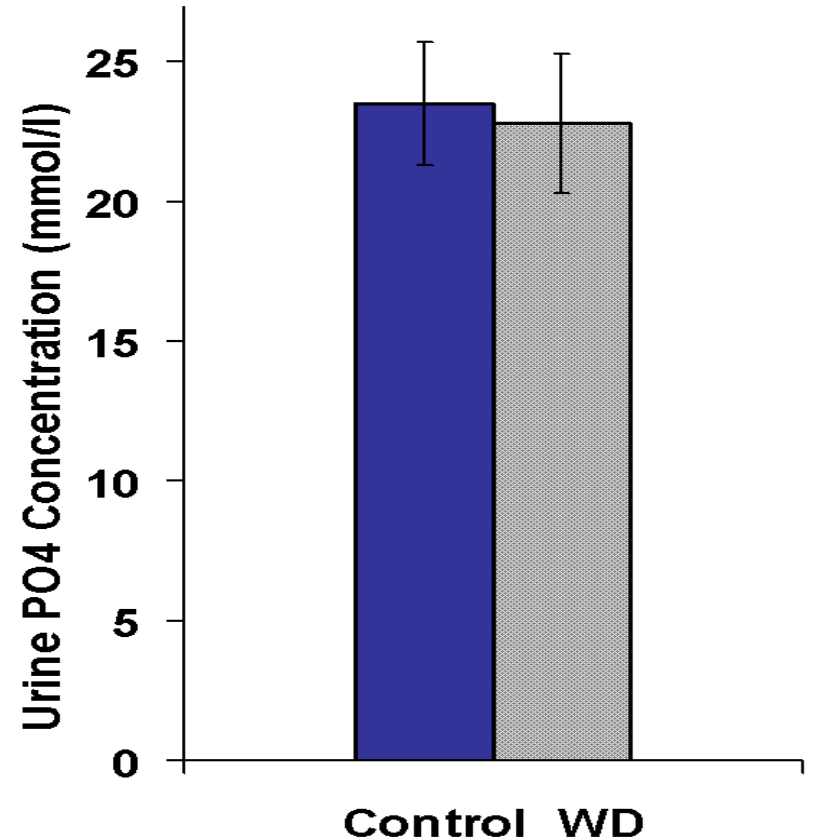
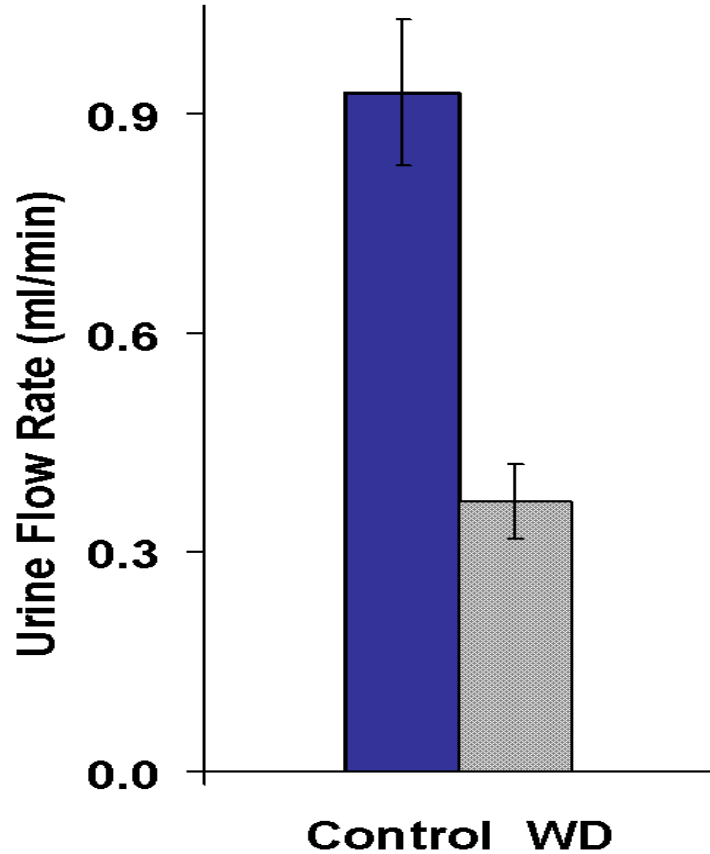
# **Precipitate Formation study**

**Is there a danger of forming  
CaPO<sub>4</sub> precipitates during  
fasting in healthy subjects?**

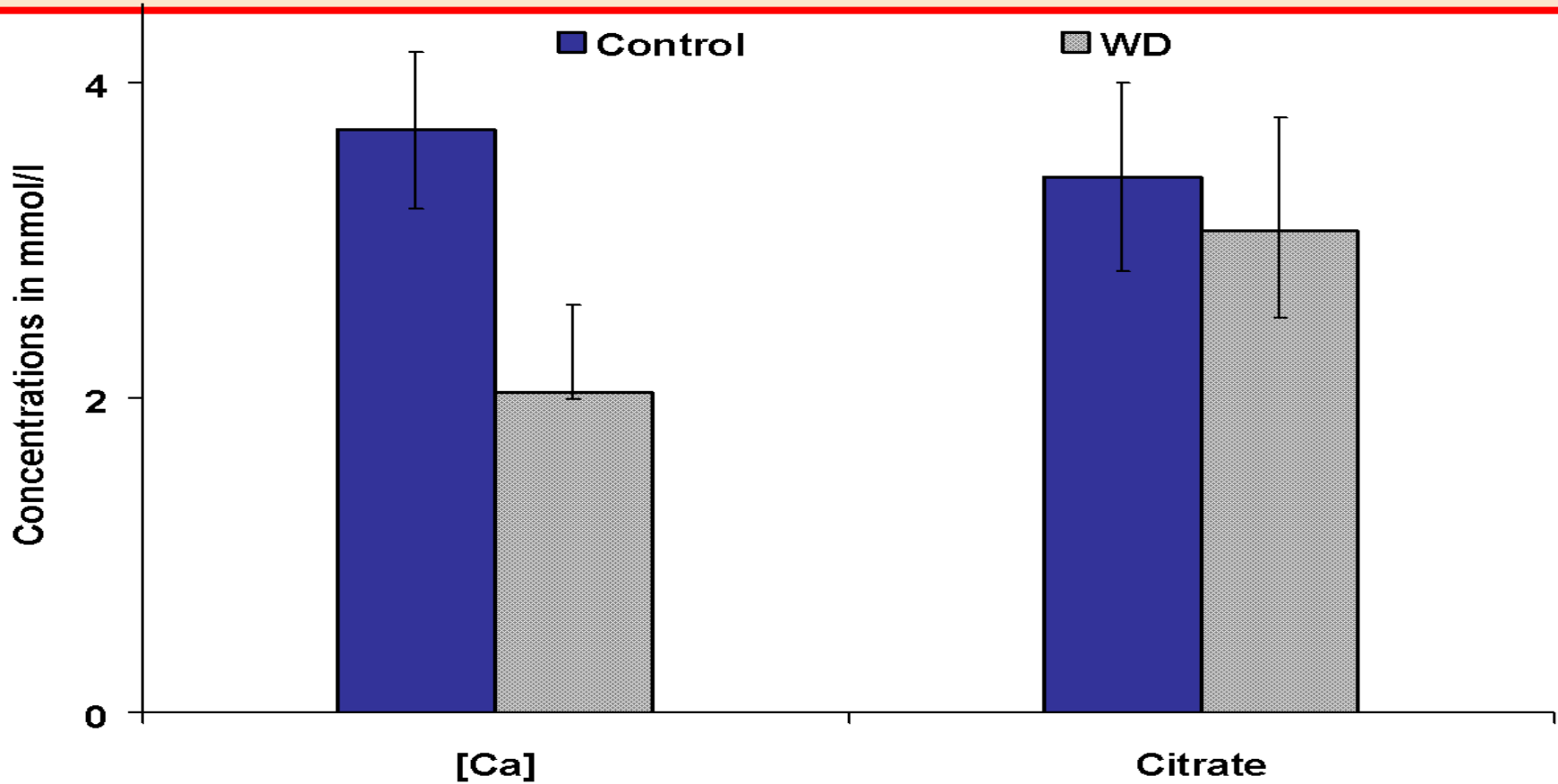
**$\downarrow \text{UFR} \approx \text{Avid Ca absorption}, \downarrow [\text{Ca}]$**



# No significant change in [PO<sub>4</sub>]



**↓[Ca] but no significant ↓ [Citrate]**



## **Take home messages:**

- Hours fasting even with drop in UFR, Ca concentration does not increase but decreases**
- But Citrate concentration does not change**
- Due to change in pH Divalent Phosphate ( $\text{HPO}_4$ ) decreases**
- Therefore, with 18h fasting risk of  $\text{CaHPO}_4$  precipitate does not increase but decreases**



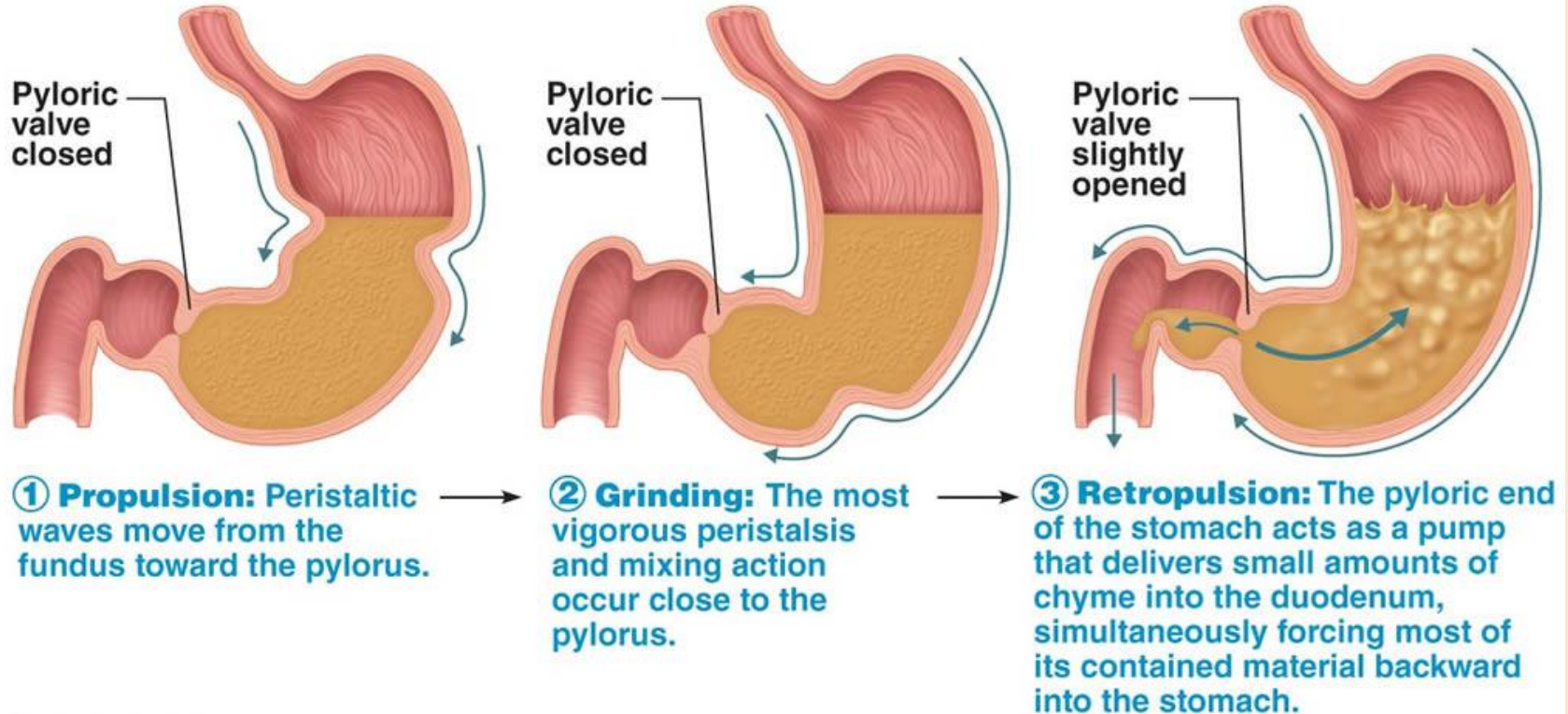
## What you shouldn't do:

## What most people do:

## As fast as they can!



# Physiology of the Stomach



# What should avoid loading?

**WHY IS THIS BAD?** By eating a lot quickly, your stomach will become closed off, and start digesting. Since there is a lot of food/fluids in your stomach now, digestion will become a long and energy consuming process. This will not allow the water to pass through, and the glucose to enter your bloodstream, and in fact, it will make your more fatigued than before you ate.





# Scientific Suggestions for Iftar?

The following are some general recommendations that could potentially be useful:

**Tip:** Split your iftar into two portions.

**Portion 1A:** Replenish your water balance, by drinking lukewarm fluids amounting to about 0.5 – 1 L. Some sugar is also recommended at this stage.

**Examples:** Sweetened tea, hot water with sugar cubes, warm sweetened milk, coffee, juice (not cold), etc.



# Scientific Suggestions for Iftar?

The following are some general recommendations that could potentially be useful:

**Tip:** Split your iftar into two portions.

**Portion 1B:** 10 minutes later (the time the water will need to pass your system):  
Refuel your glucose levels by eating a light carbohydrate based snack.

**Examples:** Shole zard (saffron rice pudding), fereni (rice custard), halva, etc.



# Scientific Suggestions for Iftar?

The following are some general recommendations that could potentially be useful:

**Tip:** Split your iftar into two portions.

**Portion 2:** Two or three hours (sometimes less) after the initial meal, start on a high nutrient meal containing essential carbohydrates, fats, and proteins.

**Remember:** Overeating will cause more harm than good, and interferes with proper digestion and absorption. It will result in fatigue and digestive system problems.



# Scientific Suggestions for Suhoor?

**What is suhoor?** A very important nutritional part, because it helps maintain your blood sugar levels, and helps prevent thirst during the day. The earlier you wake up, the more your digestive system is ready for food.

**Tip 1:** Eat complex carbohydrates. \*Complex carbohydrates are gradually digested and absorbed, and they can be a source of energy in the body for 12-18 hours after eating.

**Examples:** Pure grain, cereals containing a lot of fibre, bran, barley and vegetables.





# Scientific Suggestions for Suhoor?

**What is suhoor?** A very important nutritional part, because it helps maintain your blood sugar levels, and helps prevent thirst during the day. The earlier you wake up, the more your digestive system is ready for food.

**Tip 2:** Eat foods full of unsaturated fatty acids.

**Examples:** Walnuts and other nuts.





# Scientific Suggestions for Suhoor?

**What is suhoor?** A very important nutritional part, because it helps maintain your blood sugar levels, and helps prevent thirst during the day. The earlier you wake up, the more your digestive system is ready for food.

**Tip 3:** Eat foods rich in protein.

**Examples:** Milk, egg, yoghurt, and meat.



# Scientific Suggestions for Suhoor?

**Tip 4:** Drink fluids, such as water, in moderation, in order to balance electrolyte intake. \*Consumption of watery fruits such as watermelon can serve as another source of water absorption for the hours following suhoor.

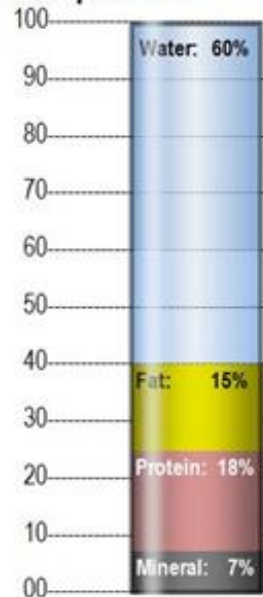
**Note:** Drinking excessively would cause the excretion of your electrolytes early in the morning. Low consumption of salts can help the body retain its water, but high levels of salt intake could cause thirst during the day. But balanced electrolyte and water concentration could help balance and maintain the water levels in your body.



# **Ramadan health guide campaign:**

- **We should support the development of the Ramadan health guide, pamphlets, and educational materials**
- **Researches about:**
  - **How does fasting affects our physiology performance and quality of life?**
  - **Which combination of foods and liquid could increase daytime efficiency?**

## Total Body Composition



Total solids = 40%  
Total Fluid = 60%

## Total body metabolic fuel



23.3 grams of circulating nutrients: 113 kcal

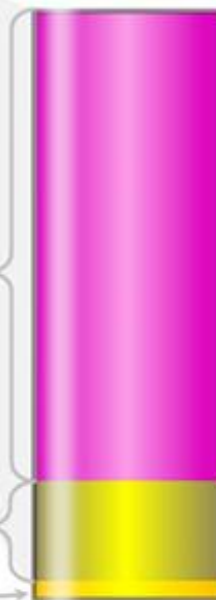
75g hepatic glycogen: 300 kcal

150g muscle glycogen: 600 kcal

6kg protein: 24,000 kcal

15kg fat: 141,000 kcal

## Circulating fuel



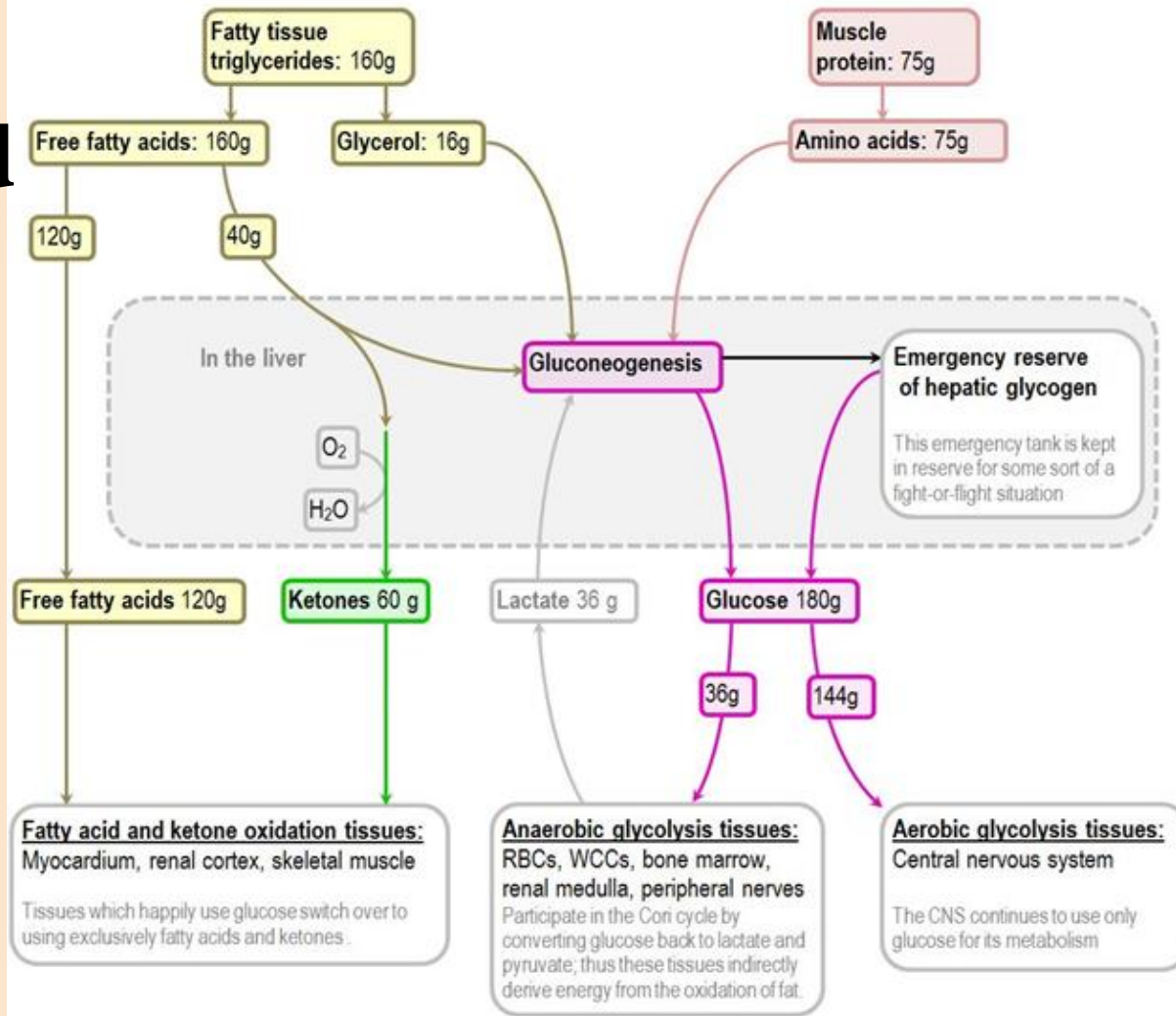
20g glucose: 80 kcal

3g triglycerides: 30 kcal

0.3g free fatty acids: 3 kcal

In total: in storage there is 165,900 kcal; in circulation there is 113kcal.

# Daily consumed nutrient



# Other Physiological/mental effect of fasting

- ↑↑ **spatial planning Performance**
- ↑↑ **working memory task/capacity test**
- ↓ **in attention**
- **Improvement in cognitive function after Ramadan**

J Acad Nutr Diet. 2015 Jun;115(6):889-97. doi: 10.1016/j.jand.2015.02.012. Epub 2015 Apr 1. **A Prospective Study of the Physiological and Neurobehavioral Effects of Ramadan Fasting in Preteen and Teenage Boys.**

Farooq A, Herrera CP, Almudahka F, Mansour R.



# Fasting during pregnancy?

- **Over 40% of women in UK fasted at least one day during ramadan**
- **Fasting not found to be associated with adverse birth outcomes in this sample**
- **No associated with Gestational DM or pre-eclampsia**
- **Women more likely to fast in 1<sup>st</sup> & 2<sup>nd</sup> trimesters**
- **3rd trimester low caloric intake related to lower birth weight**

BMC Pregnancy Childbirth. 2014 Sep 26;14:335. doi: 10.1186/1471-2393-14-335.

**Experiences and outcomes of maternal Ramadan fasting during pregnancy: results from a sub-cohort of the Born in Bradford birth cohort study.**

Petherick ES1, Tuffnell D, Wright J.

# Potential beneficial metabolic effects of fasting?

- **Associated with transient impaired insulin sensitivity, compensated by an ↑ B cell function**
- **↓ weight & improved BMI**
- **Associated with improvement in insulin sensitivity, ↓insulin resistance**
- **possible protective mechanism against DM**

Turk J Med Sci. 2014;44(6):1010-20.

**Possible metabolic impact of Ramadan fasting in healthy men.**

Vardarli MC1, Hammes HP, Vardarli İ.



# Physiological changes during Ramadan fasting

- No dramatic effect on the metabolism, or the daily mean of hormonal serum levels
- Slight fall in serum Glucose
- But ↑↑ HDL and apoprotein A1
- ↓↓ LDL, could be beneficial for the cardiovascular system
- Slight ↓→ in Total Cholesterol & Triglycerides

**Physiological and chronobiological changes during intermittent fasting. Roky R, Casablanca**

J Res Med Sci. 2014 Oct;19(10):987-92.

Is Ramadan fasting related to health outcomes?

A review on the related evidence.

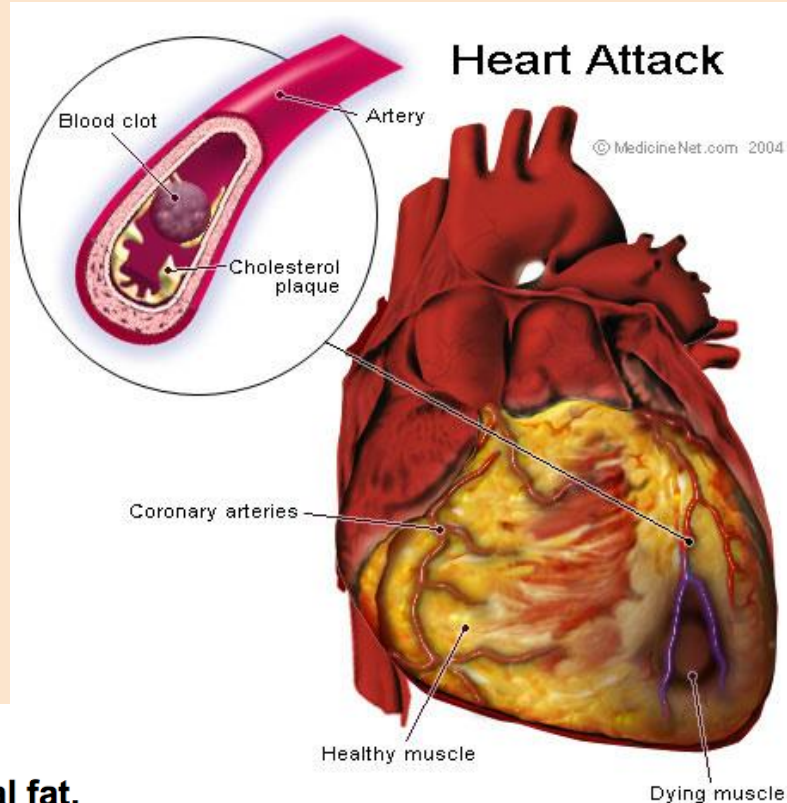
# Visceral fat and heart disease

- Visceral fat is metabolically active and puts a lot of stress on heart.
- It is the type of fat that is metabolized by the liver, which turns it into cholesterol that circulates in the blood.
- "Bad" cholesterol, called low-density lipoproteins or LDL, collects in the arteries where it forms plaque, a waxy substance that narrows the arteries.

Crit Pathw Cardiol. 2007 Jun;6(2):51-9.

**Cardiovascular disease under the influence of excess visceral fat.**

Després JP<sup>1</sup>.




# How to measure visceral fat?

- MRI (expensive and not feasible)
- - Waistline measurement, Harvard University notes around 10% of our total fat is likely to be stored as visceral fat.

## b. WAIST CIRCUMFERENCE

to measure visceral fat which contributes to more risk of cardiovascular disease and diabetes than fat located in other areas



	MEN		WOMEN	
Risk	Centimeter	Inches	Centimeter	Inches
Very High	>120	>47	>110	>43.5
High	100 - 120	39.5 - 47	90 - 109	35.5 - 43
Normal	102	40	88	34.6
Low	80 - 99	31.5 - 39	70 - 89	28.5 - 35
Very Low	<80	<31.5	<70	<28.5



# Visceral fat amounts

TABLE 1. *First and second measurements of each parameter of all volunteers*

Parameters	No. of Patients ( <i>n</i> )	1st Measurement mean $\pm$ S.D.	2nd Measurement mean $\pm$ S.D.	<i>p</i> value*
Fat area (cm <sup>2</sup> )				
Total	38	493.09 $\pm$ 144.66	486.42 $\pm$ 159.37	0.242
Subcutaneous	38	330.99 $\pm$ 109.36	331.46 $\pm$ 118.25	0.922
Visceral	38	162.10 $\pm$ 57.52	155.36 $\pm$ 59.29	0.054
Weight	34	68.67 $\pm$ 14.43	68.64 $\pm$ 14.66	0.894
Waist circumference	34	83.29 $\pm$ 13.21	83.44 $\pm$ 12.82	0.822
Hip circumference	34	99.94 $\pm$ 7.87	99.75 $\pm$ 7.38	0.669
Thigh circumference	34	54.66 $\pm$ 4.16	56.25 $\pm$ 8.04	0.198
BMI	34	24.63 $\pm$ 4.39	24.60 $\pm$ 4.36	0.764
WHR	34	0.83 $\pm$ 0.00	0.83 $\pm$ 0.00	0.590
WTR	34	1.52 $\pm$ 0.21	1.49 $\pm$ 0.23	0.275

\* Compared by using the paired *t*-test.