Congresso Società Italiana di Gerontologia e Geriatria
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# L'osso e altri sistemi: Il metabolismo energetico


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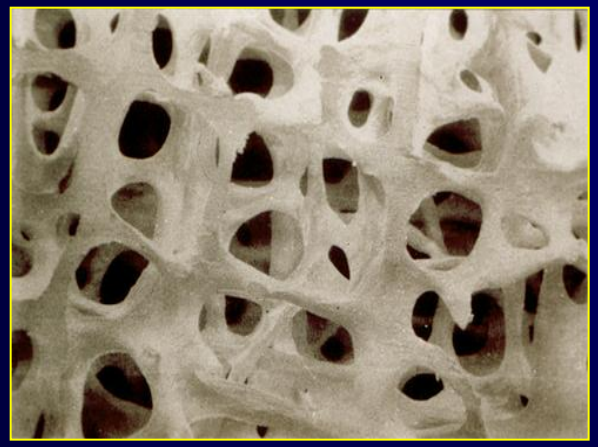
# Age-Related Changes in the Endocrine System

- In most glands there is some atrophy & decreased secretion with age, but the clinical implications of this are not fully known.

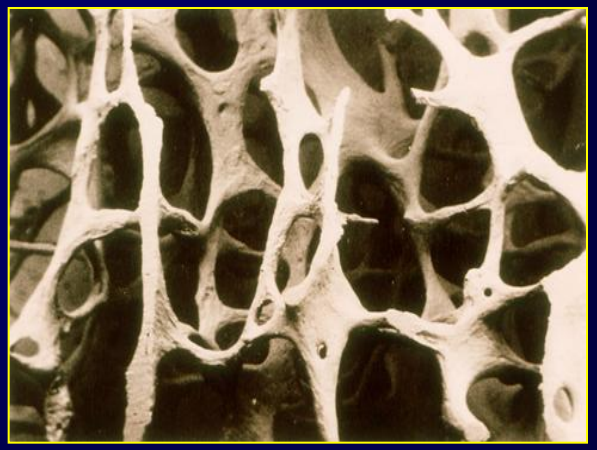
- What may be different is hormonal action.

# Osteoporosis

Osteoporosis is a skeletal disorder characterized by compromised bone strenght which predisposes an individual to an increased risk of fracture. Bone strenght reflects the integration between bone **density** e **quality**.



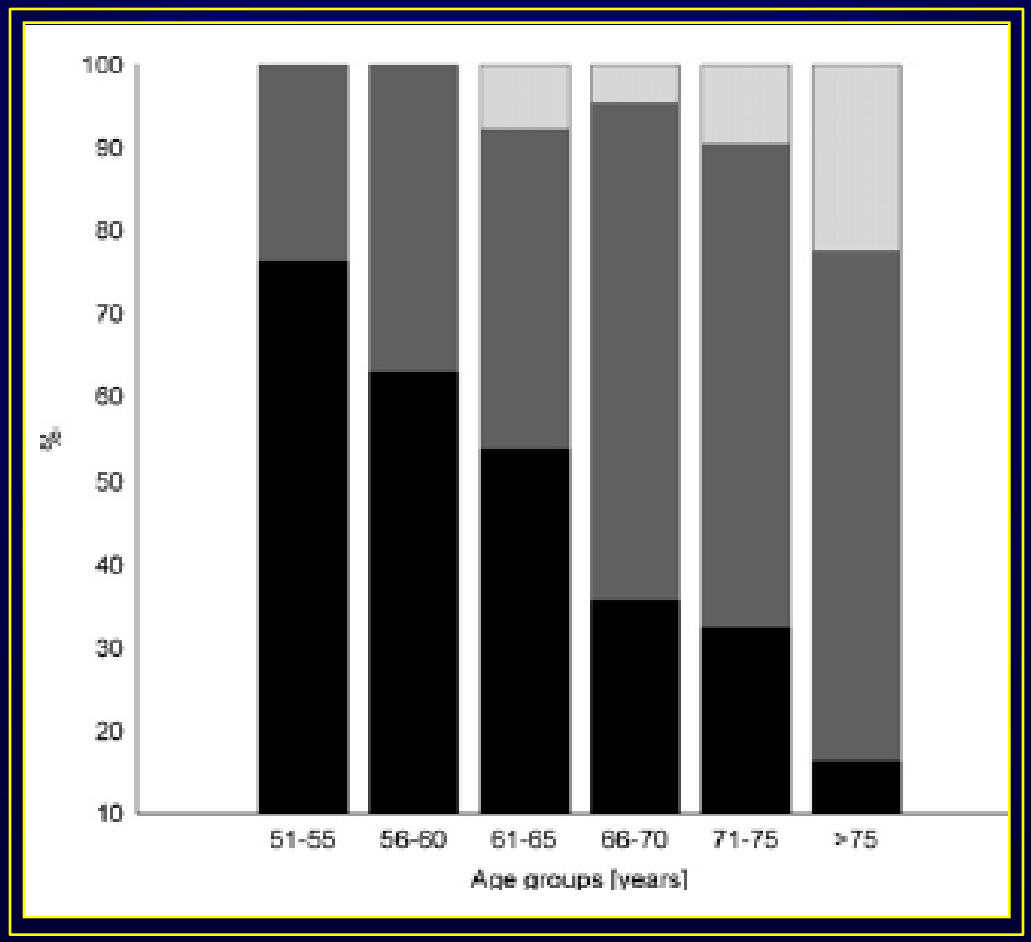
Normal bone



Osteoporotic bone

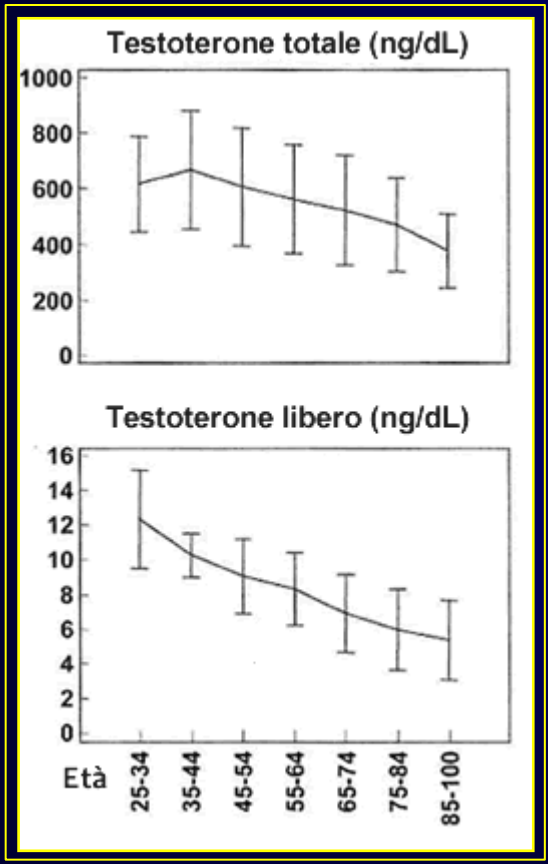
NIH Consensus Development Panel on Osteoporosis *JAMA* 285:785-95; 2001

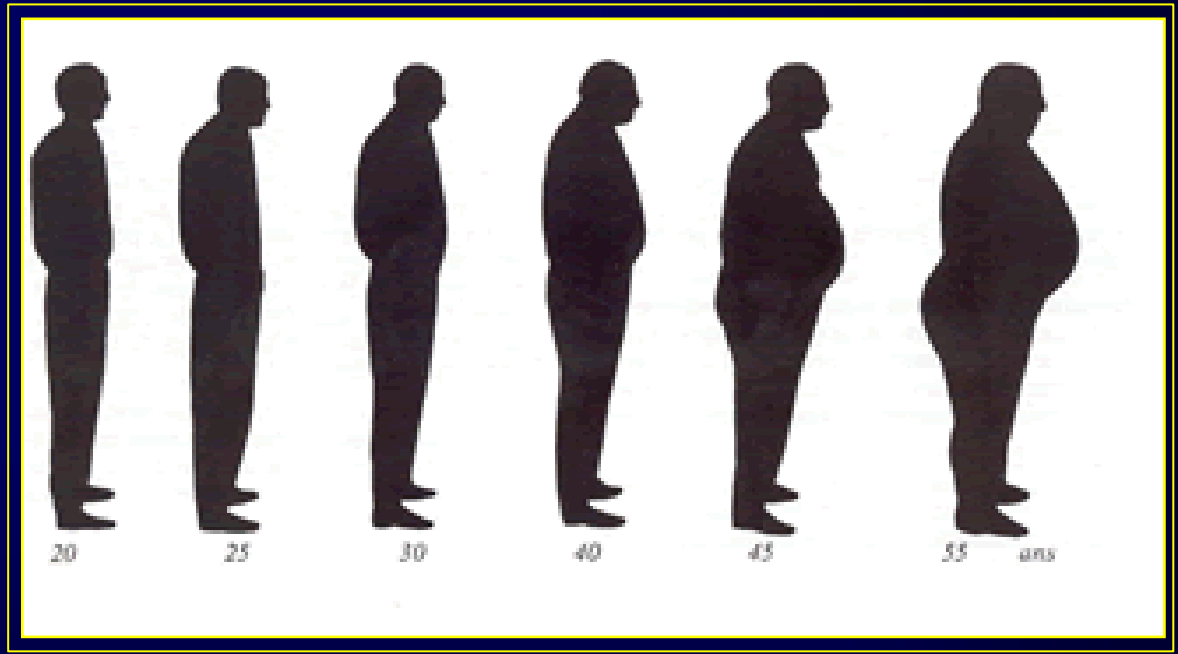
# Presence of BMD alteration in ageing population



# Modificazioni Scheletriche

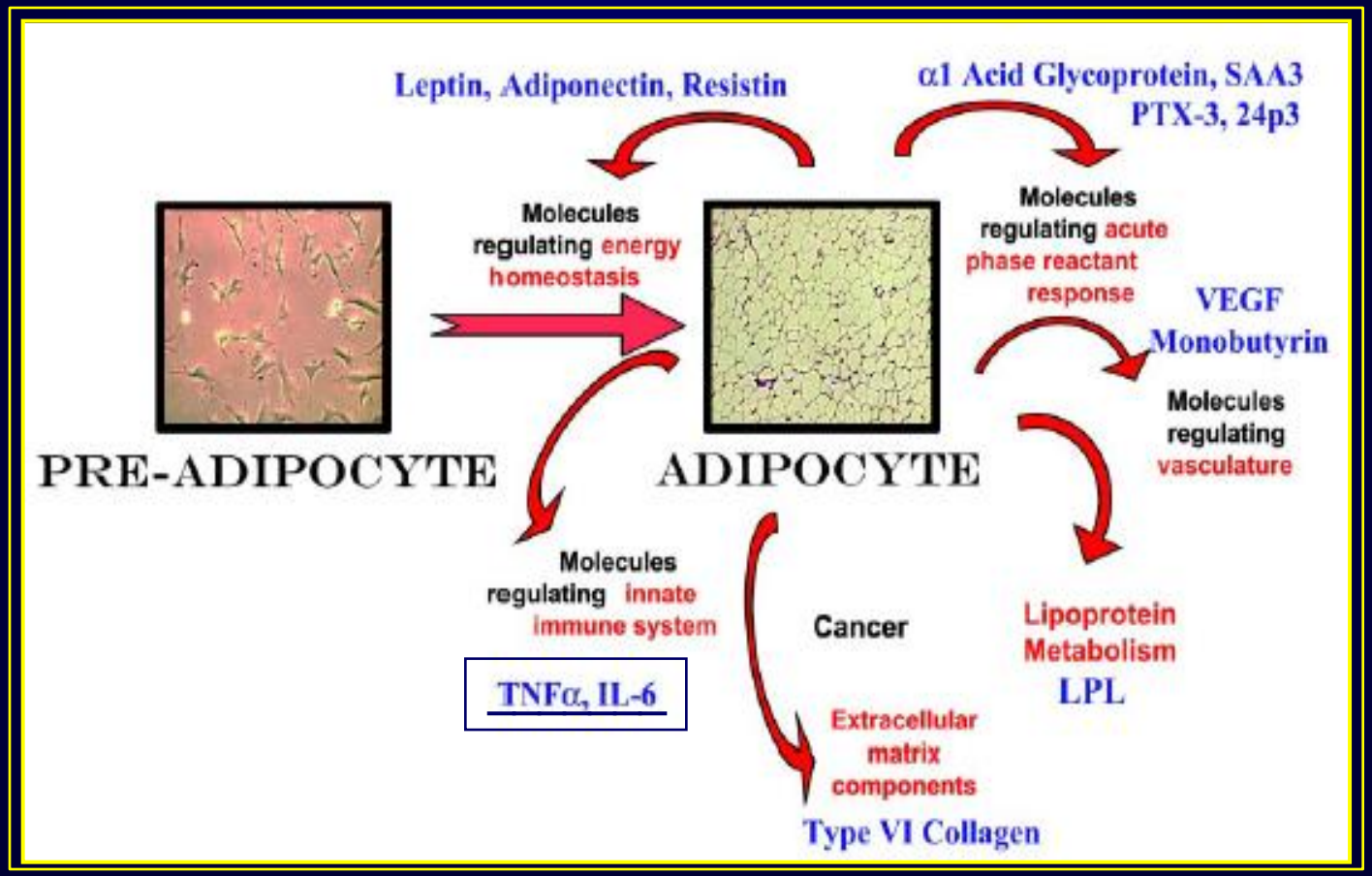
# Invecchiamento, modificazioni ormonali e cambiamento composizione corporea



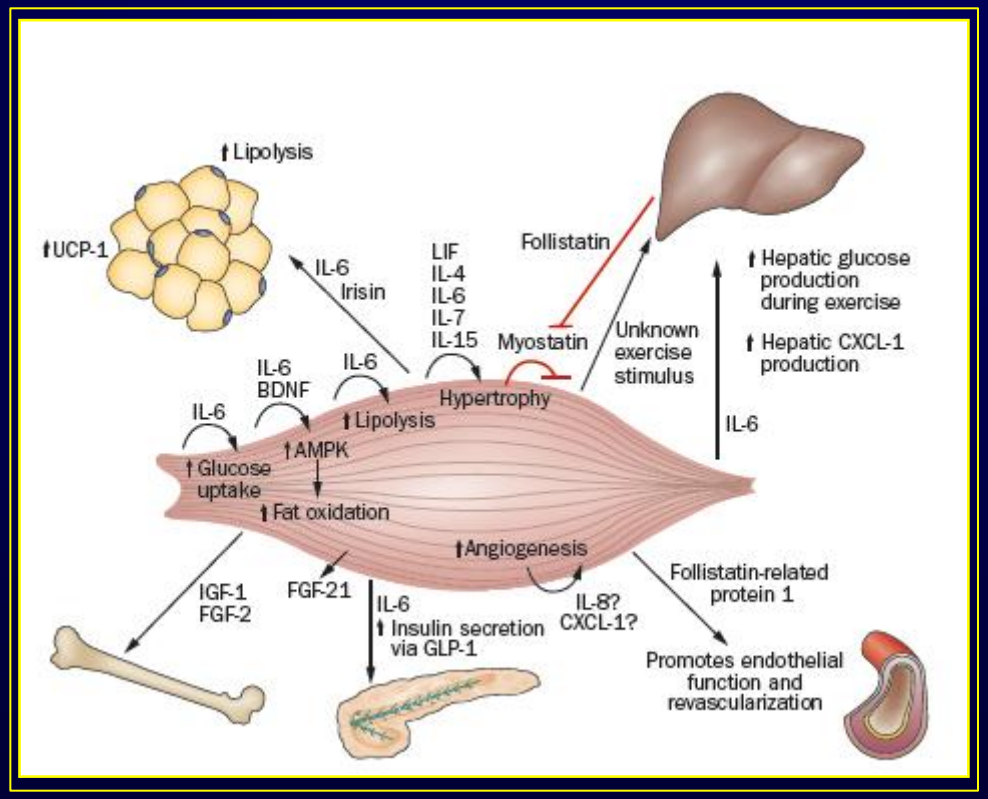

PESO ESATTAMENTE QUANTO PESAVO 25 ANNI FA!

# Adipose tissue as an endocrine organ



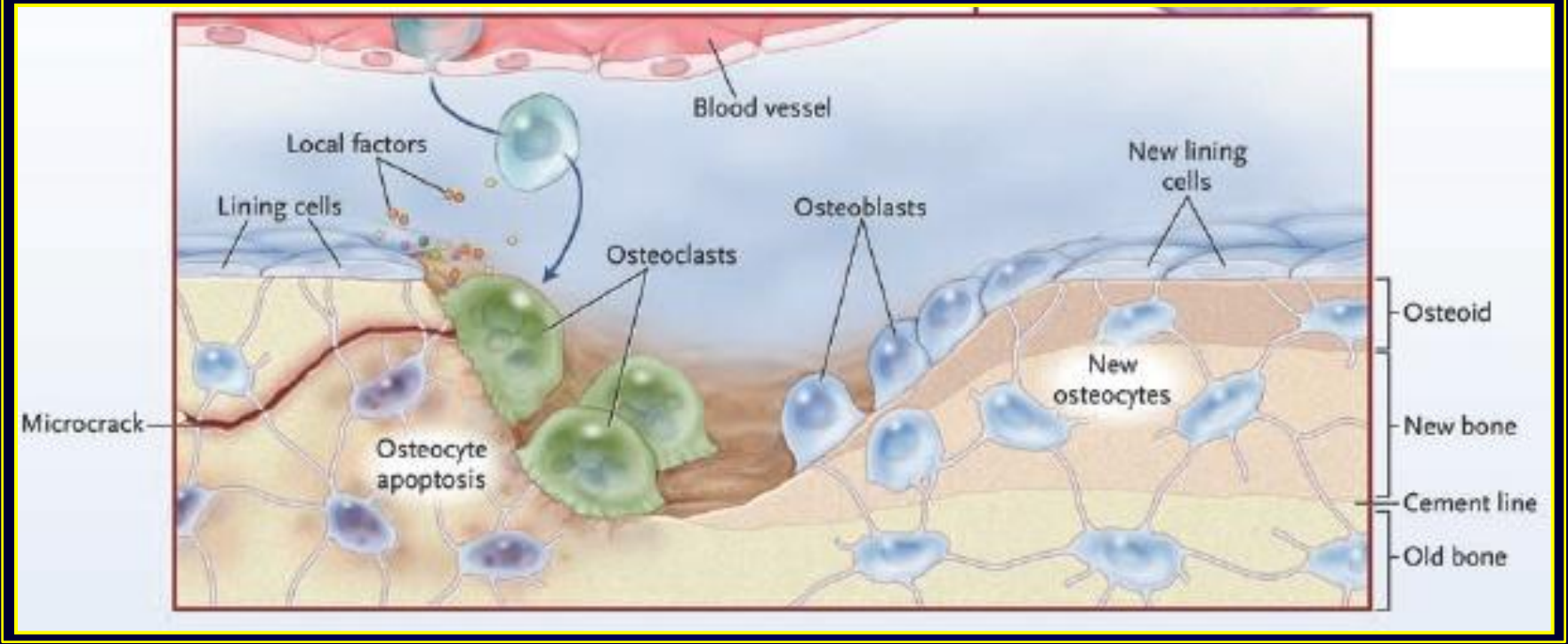

Rajala & Scherer, Endocrinology 144: 2375, 2003

# Skeletal Muscle as an endocrine organ modulating activity of different tissues




Pedersen & Febbraio, Physiol Rev 2008;88:1379-406; Nature Rev, 8:457-65, 2012

# BONE REMODELING and SKELETAL HEALTH




Canalis, Giustina, Bilezikian, NEJM 305:905-916, 2007

Online Submissions: http://www.wjgnet.com/esps/
wjo@wjgnet.com
doi:10.5312/wjo.v3.i11.190

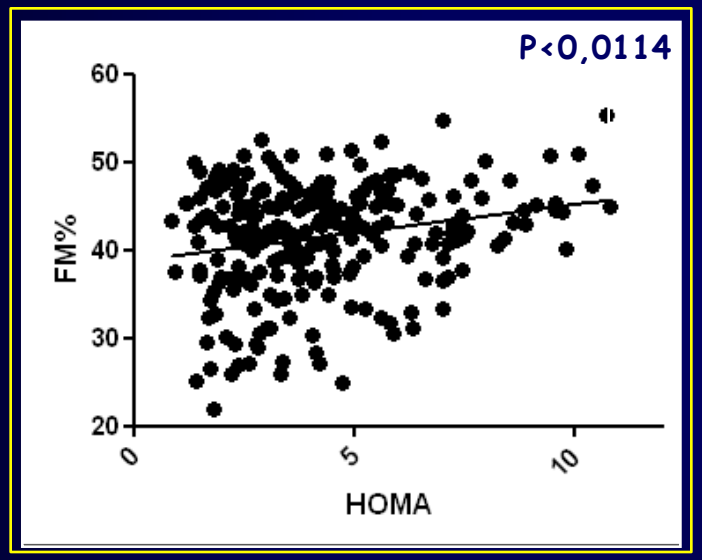
*World J Orthop* 2012 November 18; 3(11): 190-198
ISSN 2218-5836 (online)

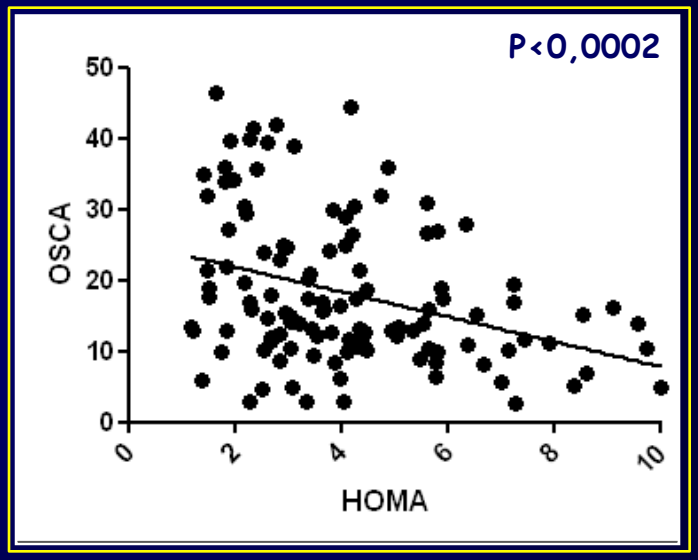

REVIEW

# Energy metabolism and the skeleton: Reciprocal interplay

Patrizia D'Amelio, Anna Panico, Elena Spertino, Giovanni Carlo Isaia

# Obesity & HOMA



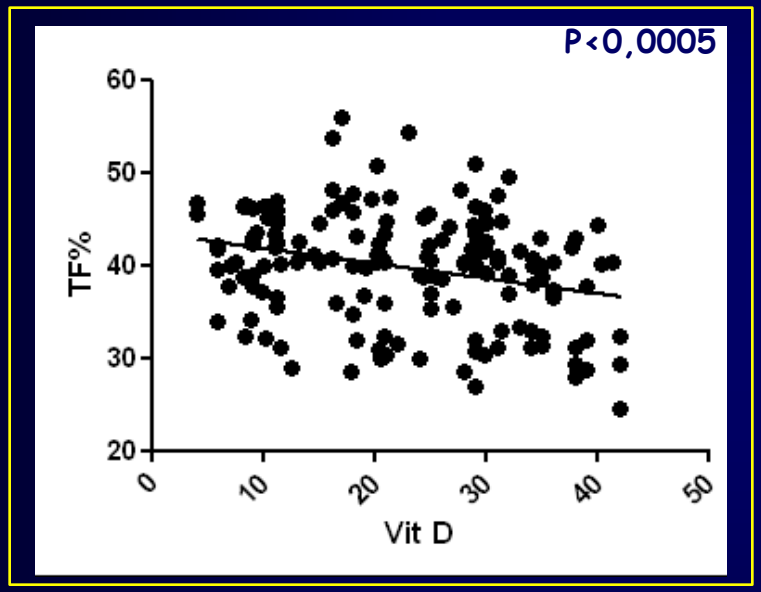

Greco, et al., World J Diabetes 2013

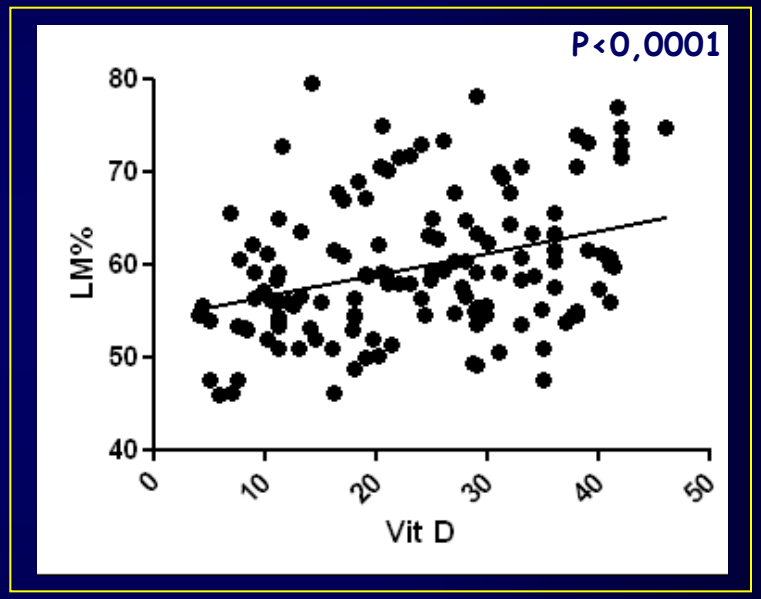
# Vitamin D status and bone histomorphometry in gross obesity[1-3]

*Juliet E. Compston, M.D., M.R.C.P., Shobna Vedi, M.Sc., Julia E. Ledger, M.Sc., Adrian Webb, Jean-Claude Gazet, M.S., F.R.C.S., and Thomas R. E. Pilkington, M.D., M.R.C.P.*

Am J Clin Nutr 34:2359-2363, 1981

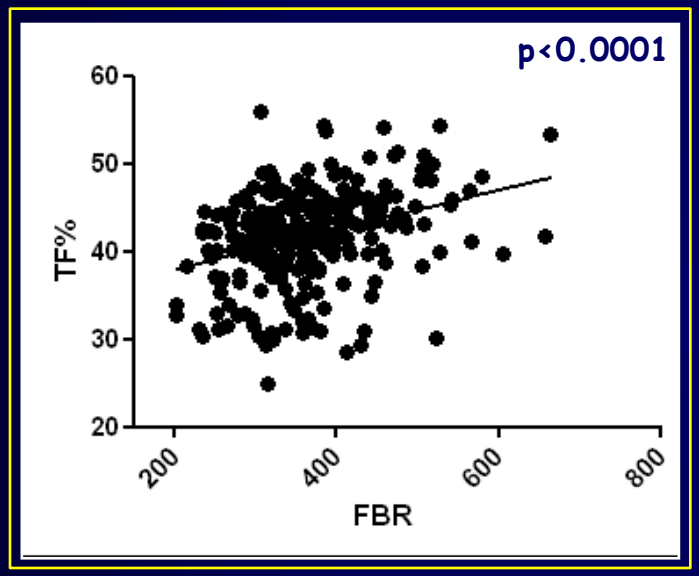
# Composizione corporea & Vitamina D

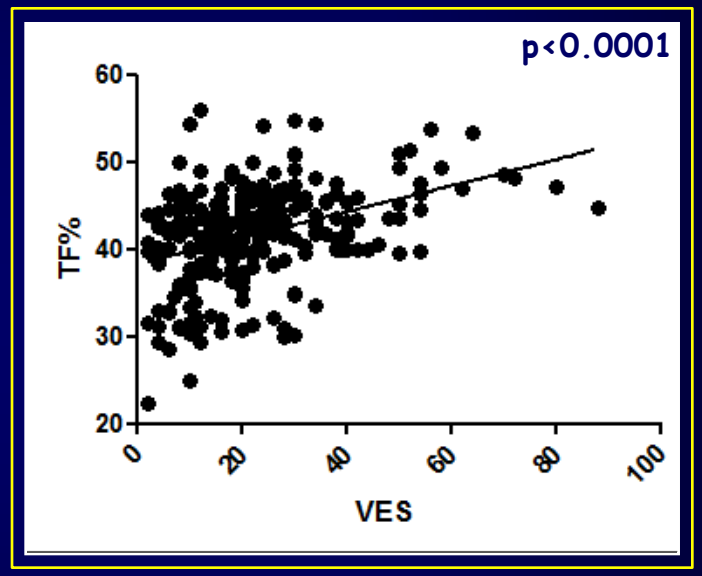



Greco,et al., W J Diabetes 2013; Migliaccio et al Int J Endocrinol 2013

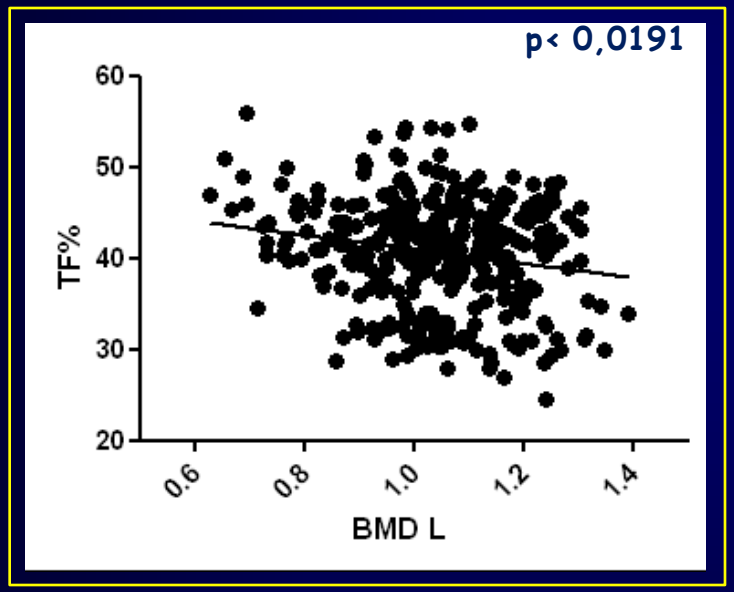
# Grasso addominale & infiammazione

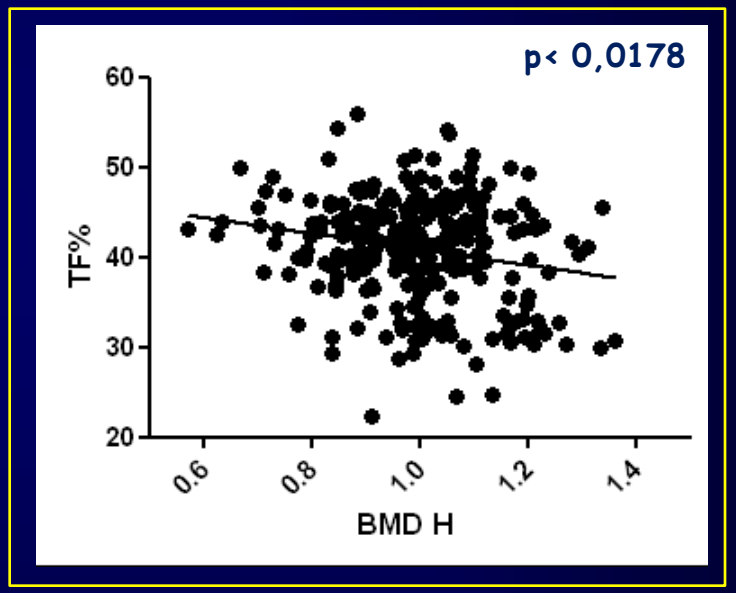



Greco, et al., World J Endocrinol 2013

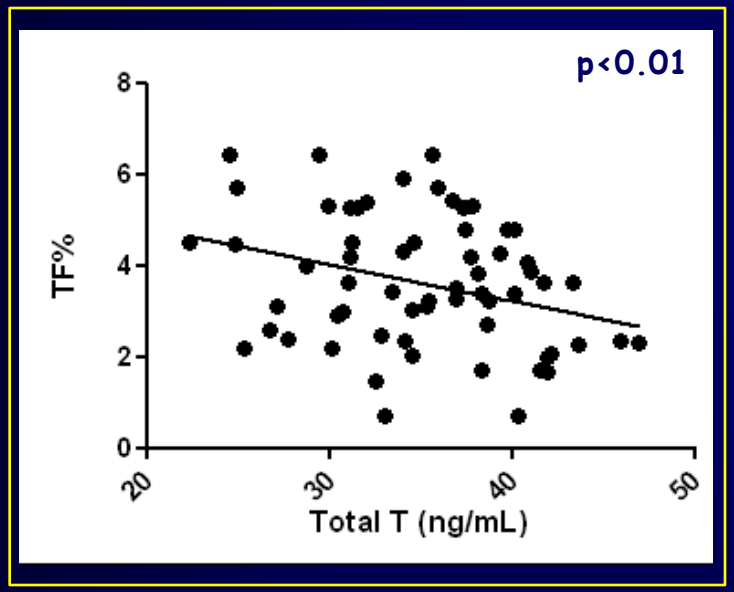
# Grasso addominale correla con bassa BMD in donne

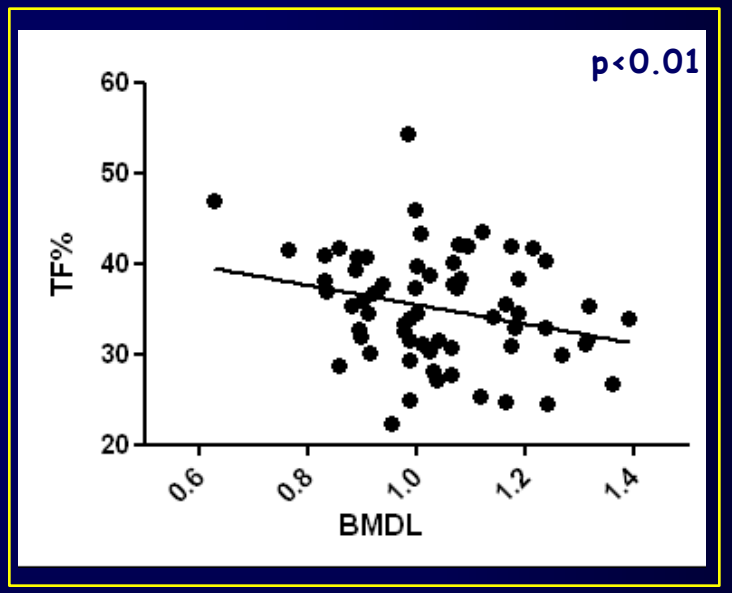



Greco, et al., World J Diabetes 2013

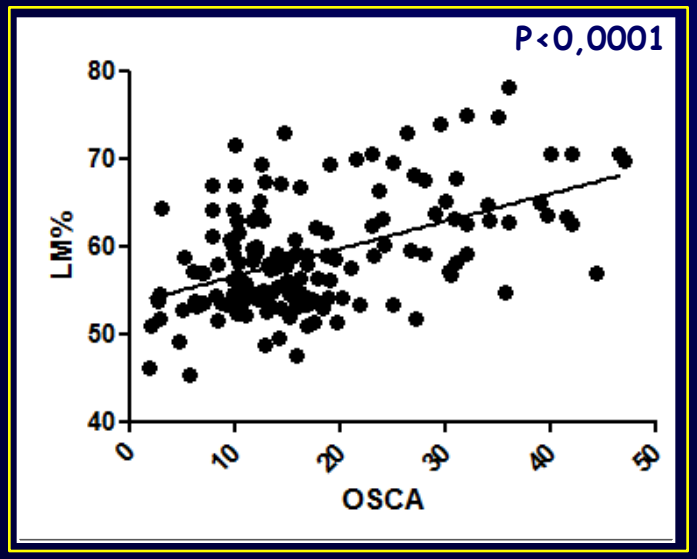
# Grasso addominale correla con basso Testosterone & bassa BMD in uomini

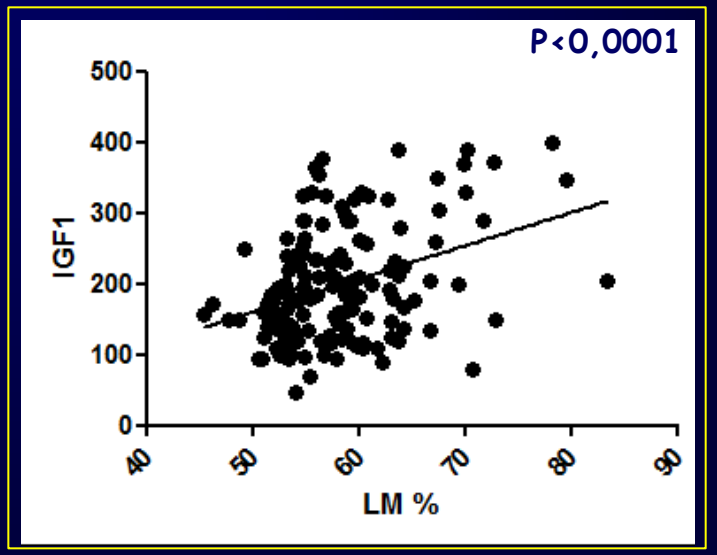



Migliaccio et al, Int'nal J Endocrinol 2013

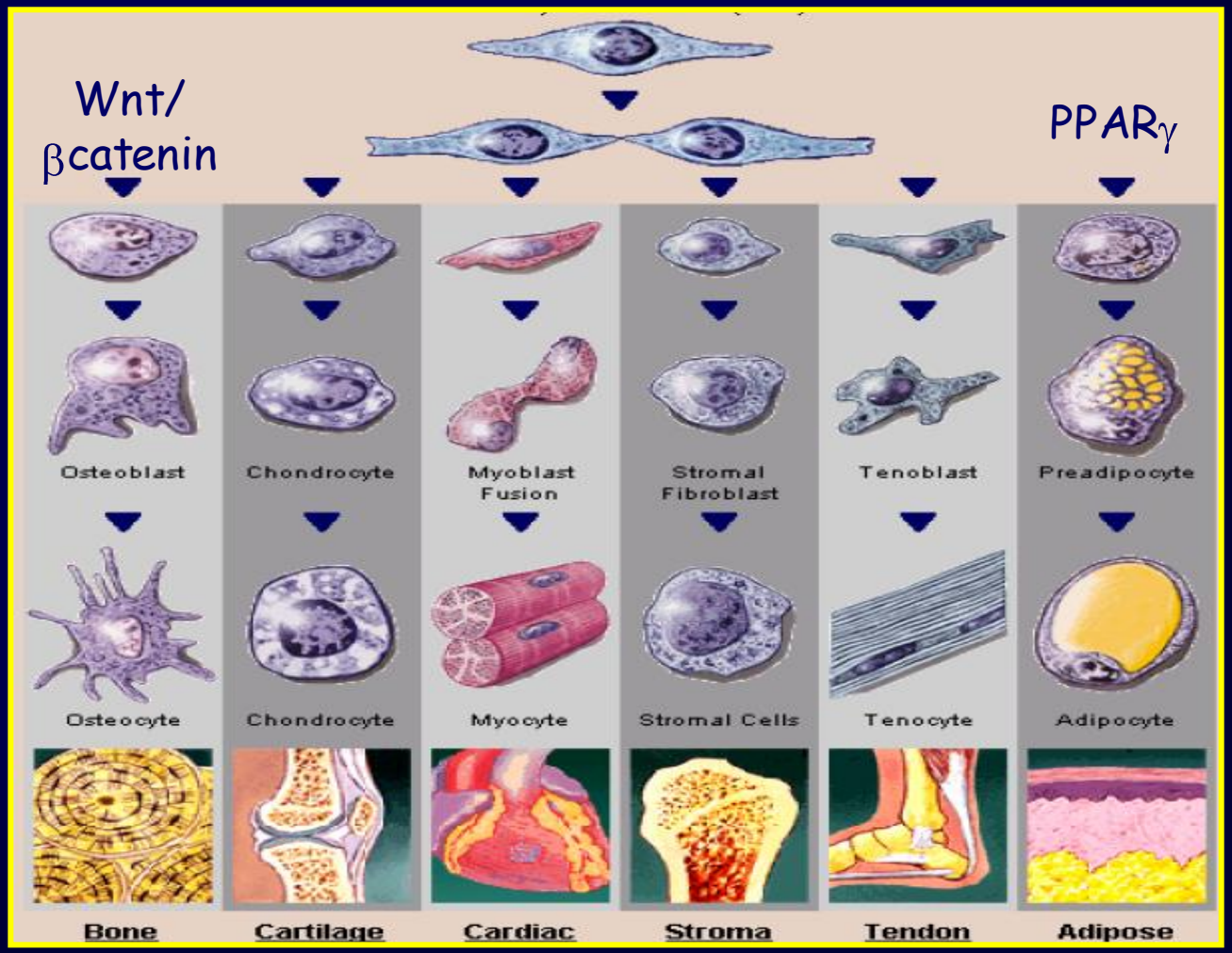
# Muscle Mass correlates with OSCA e IGF-1 levels



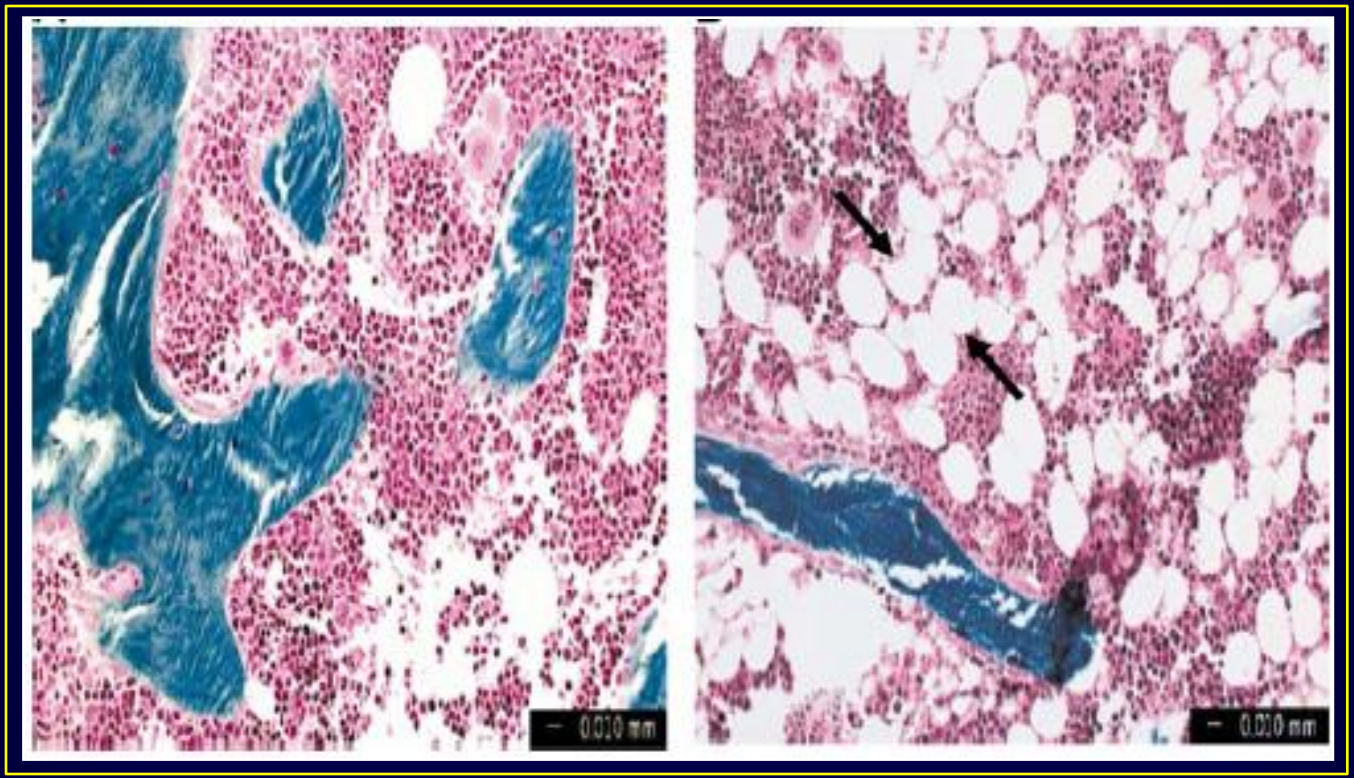




Greco, et al., W J Diabetes 2013

# Obesity & Sarcopenia & Osteoporosis: "multiple faces of the same problem"?

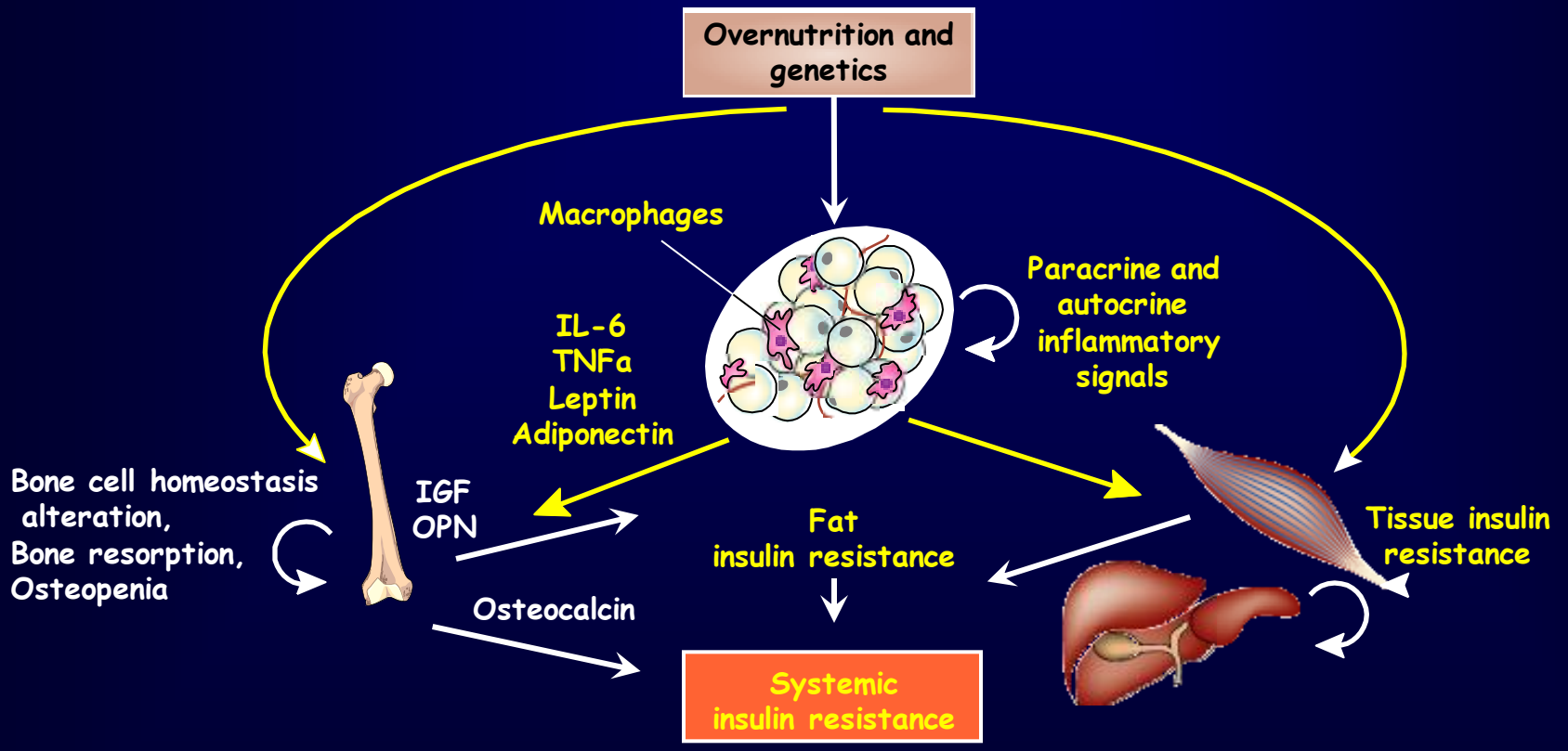


# Increased levels of marrow adipose tissue (MAT) in ageing



Fazeli et at JCEM 98:935-945, 2013

# Cross-talk regulation between adipose & muscle & skeletal tissue




Modified from de Luca C, Olefsky JM. *Nat Med.* 2006;12:41-2.
Lau DCW et al. *Am J Physiol Heart Circ Physiol.* 2005;288:H2031-41.

# Acknowledgments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Unit of Endocrinology

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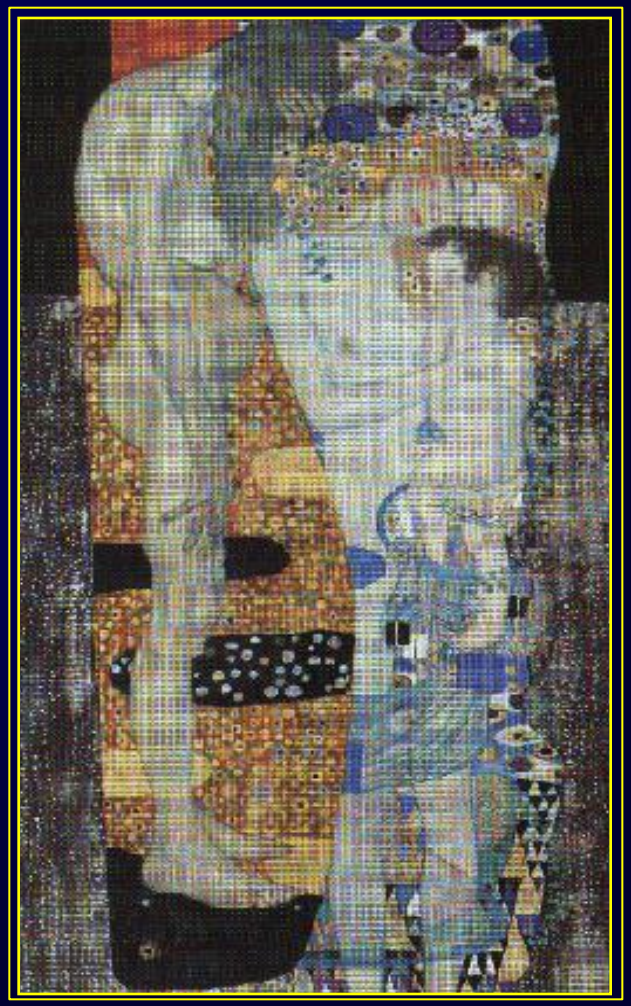
Unit of Exercise & Sport Sciences

Carlo Baldari
Laura Guidetti
GianPietro Emerenziani

## "Le tre età dell'uomo", Giorgione

## Le Tre Età, Klimt



# Back up slides

# Pros & Contro

**Table 2** Support for and against the hypothesis that fat is protective for the skeleton.

| For (obesity protective) | Against (obesity detrimental) |
|---|---|
| Increased loading on the cortical skeleton | Inflammatory cytokines impair bone formation |
| Increased protection against falls and fractures | Fatty acids stimulate resorption |
| Leptin directly stimulates bone formation | Leptin inhibits bone formation via sympathetic system |
| Greater aromatase activity increases estradiol, which would lead to:<br>decreased bone resorption due to inhibition of RANKL<br>?stimulation of bone formation<br>?decreased sympathetic tone | Hyperglycemia impairs bone formation |
| | Insulinopenia impairs bone formation |
| | PPARγ activation, which would lead to:<br>inhibition of bone formation<br>stimulation of resorption |

PPARγ, peroxisome proliferative activated receptors; RANK, receptor activator of nuclear factor κB (tumor necrosis factor receptor superfamily, member 11a).

Rosen & Bouxein Nature Clin Pract 2006

Cao *Journal of Orthopaedic Surgery and Research* 2011, **6**:30
http://www.josr-online.com/content/6/1/30

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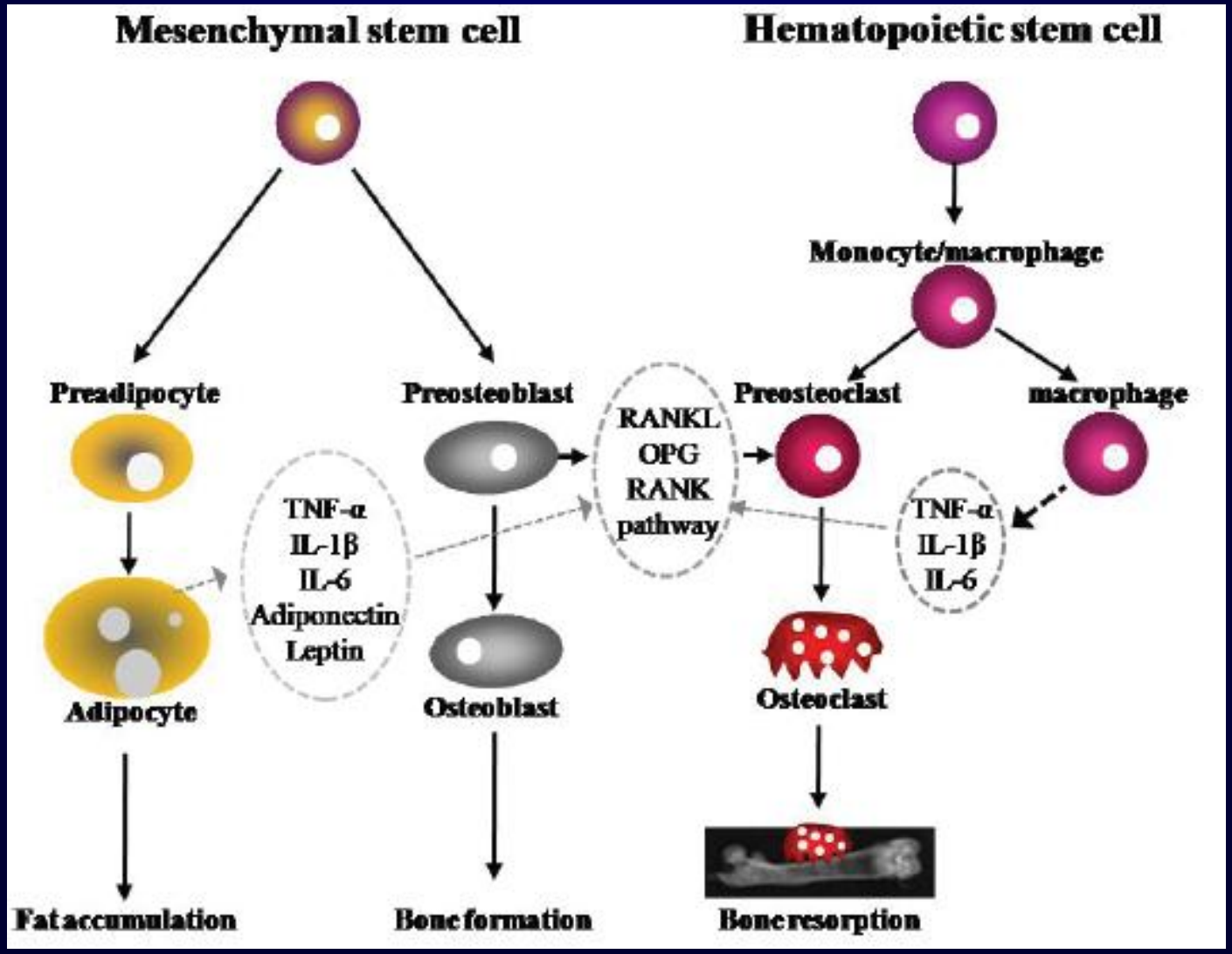
**REVIEW** **Open Access**

# Effects of obesity on bone metabolism

Jay J Cao

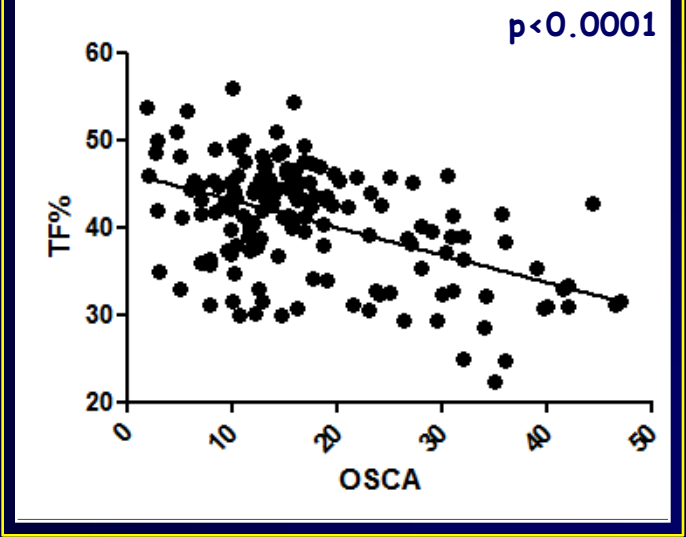

Mesenchymal stem cell
Hematopoietic stem cell
Monocyte/macrophage
Preadipocyte
Preosteoblast
Preosteoclast
macrophage
RANKL
OPG
RANK
pathway
TNF-α
IL-1β
IL-6
Adiponectin
Leptin
TNF-α
IL-1β
IL-6
Adipocyte
Osteoblast
Osteoclast
Fat accumulation
Bone formation
Bone resorption

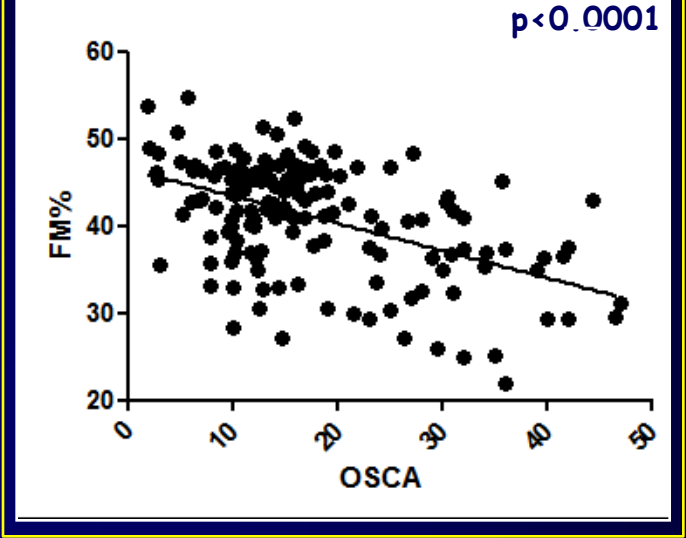
# BMI: Body Mass Index

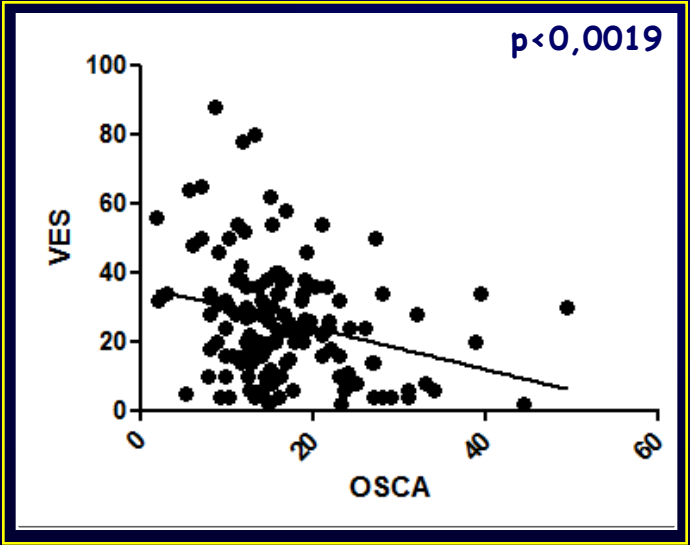
- Useful tool to classify body weight in adult individual
- BMI correlates with total body fat. Relationship between BMI and fat mass is modified up to age and sex (i.e Women have more fat than men even with equal BMI and, for instance, aged individuals have more fat and less muscle with equal BMI).

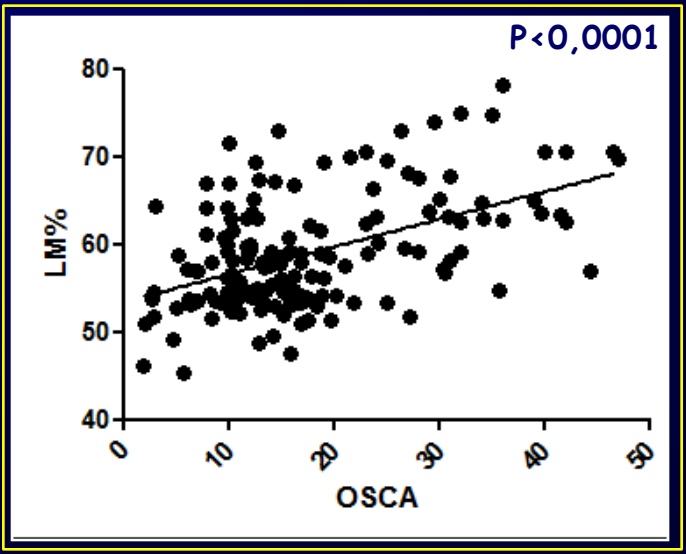
| BMI | Body weight evaluation |
|---|---|
| < 18.5 | Underweight |
| 18.5-24.9 | Normal |
| 25.0-29.9 | Overweight |
| > 30.0 | Obesity |

# Abdominal Fat Mass & Osteocalcin Level




Greco, Francomano et al., WJ Diabetes 2013