

Is metabolically healthy obesity (MHO)

Contents

- **What is MHO?**

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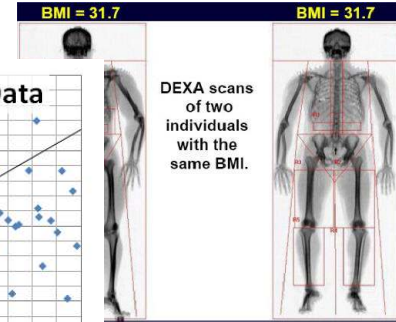
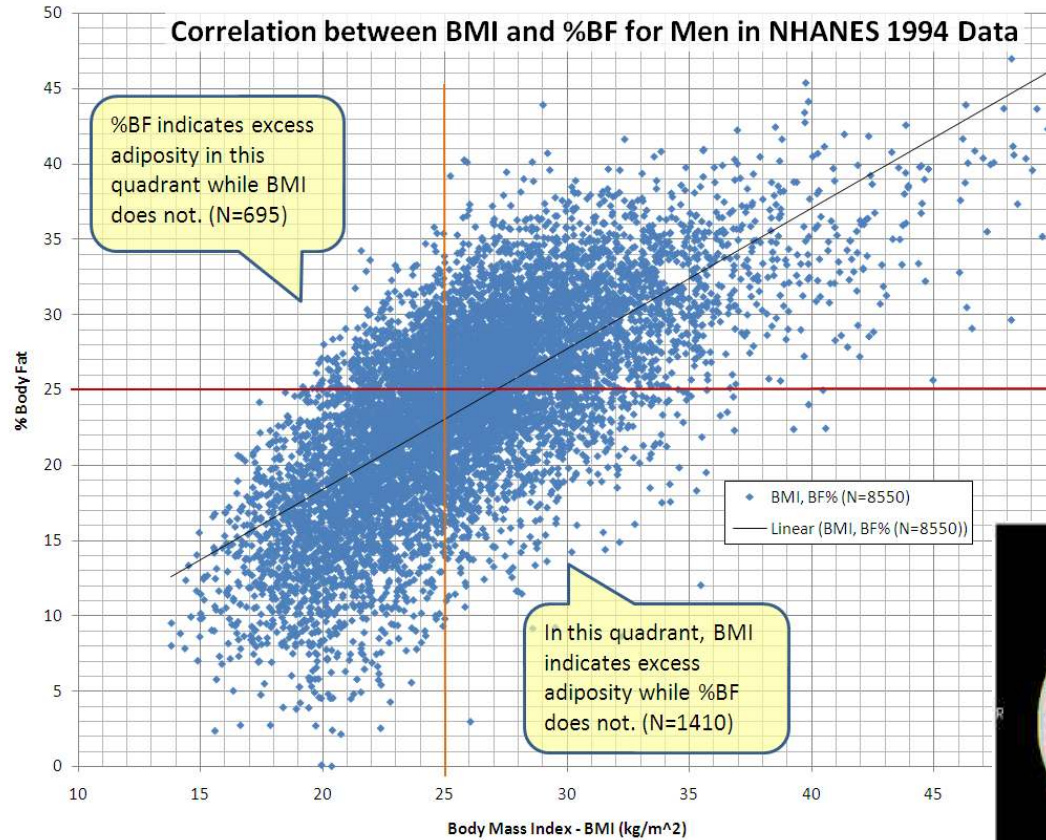
What is 'Obesity'?

- **Overweight and obesity** are defined as abnormal or excessive fat accumulation that may impair health. (WHO)

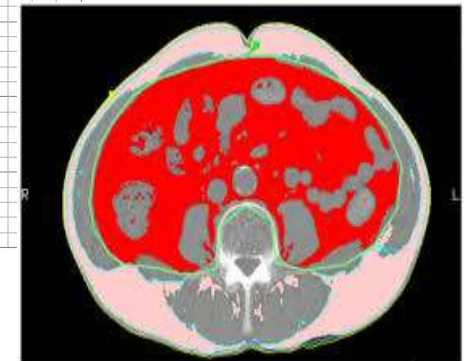
Body Fatness (Adiposity)



BMI: not a direct fatness, but a surrogate marker



DEXA



CT



Skin Fold Calipers

Same BMI \neq Same Fat

60



Same BMI



Obesity in Asian : Y-Y Paradox

BMI

22.3

22.3



BMI: Proposed Asian Criteria

**Classification of
obesity**

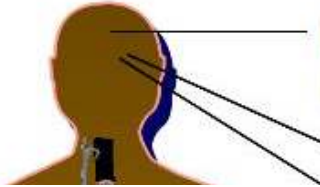
BMI (kg/m²)



Medical Complications of Obesity

Pulmonary disease

abnormal function
obstructive sleep apnea



**Idiopathic intracranial
hypertension**

Stroke

How Obesity Causes Disease: Adipose Tissue as an Endocrine Organ



Sick Fat Disease + Fat Mass Disease

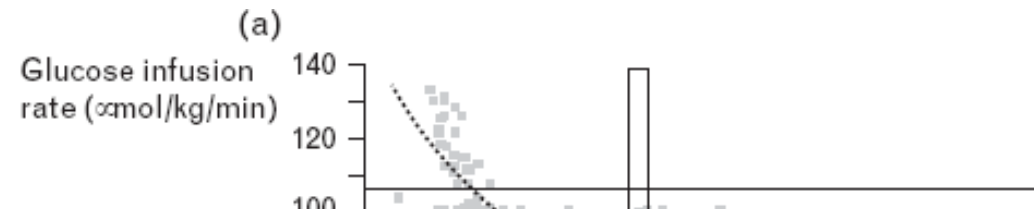
**Within subsets of patients with
overweight and/or obesity**



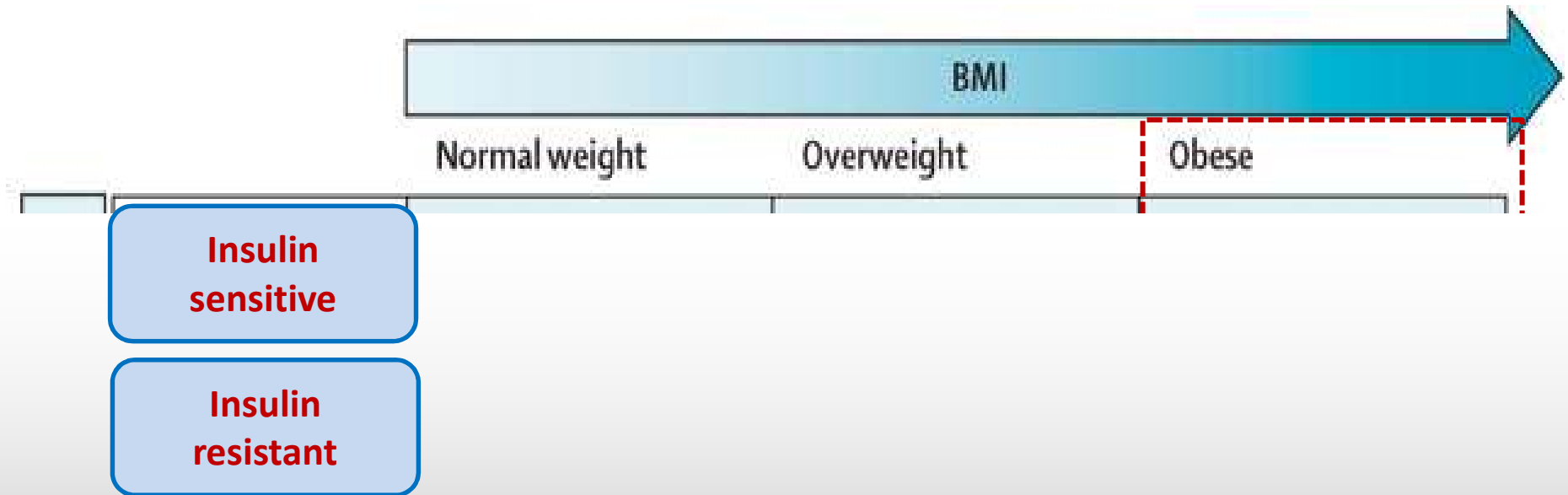
Can Obesity Be Healthy? (Sick Fat Disease)



The Heterogeneity Despite Same BMI



Classification

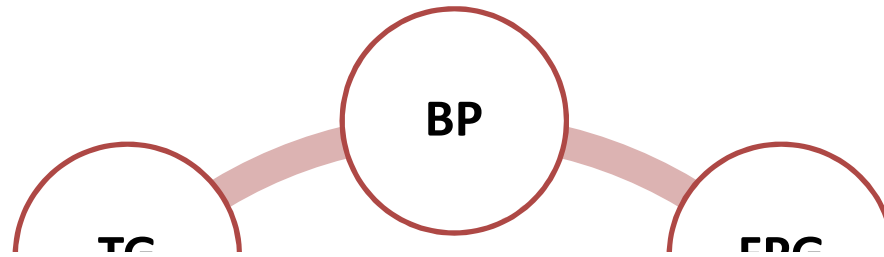


Prevalence of MHO

Metabolically Abnormal vs. Metabolically Healthy Obese




Prevalence of MHO: Definition Dependent



The Definition of MHO: Not Standardized

	Aguilar-Salinas	Karelis	Meigs	Wildman	NCEP ATP III
RD	○	-	○	○	○



The Prevalence of MHO : Definition-dependent

a

sq

b | BMI



The Prevalence of MHO in “Korea” : Definition-dependent

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Contents

- What is MHO?

Proposed Features of MHO

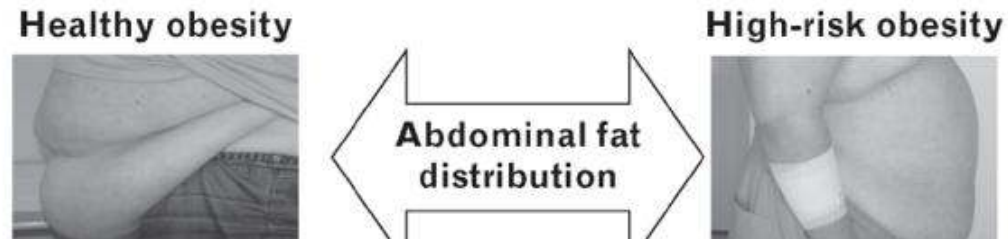
↑ Aerobic fitness



Healthier lifestyle

↑ Vascular adiposity

Proposed Mechanisms underlying MHO



Difference in Adipose Tissue

BMI=45.2 kg/m²

A

Insulin sensitive



Insulin resistant

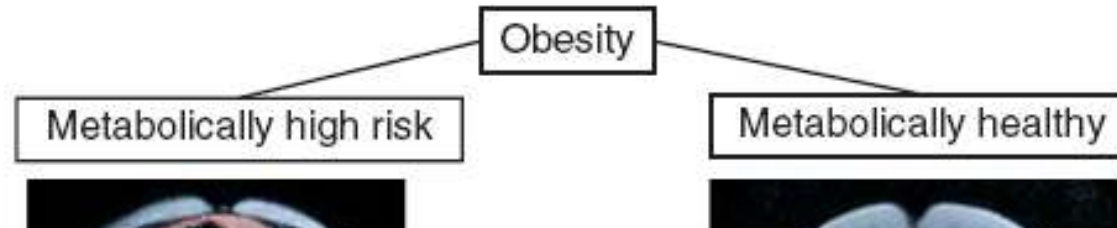


B

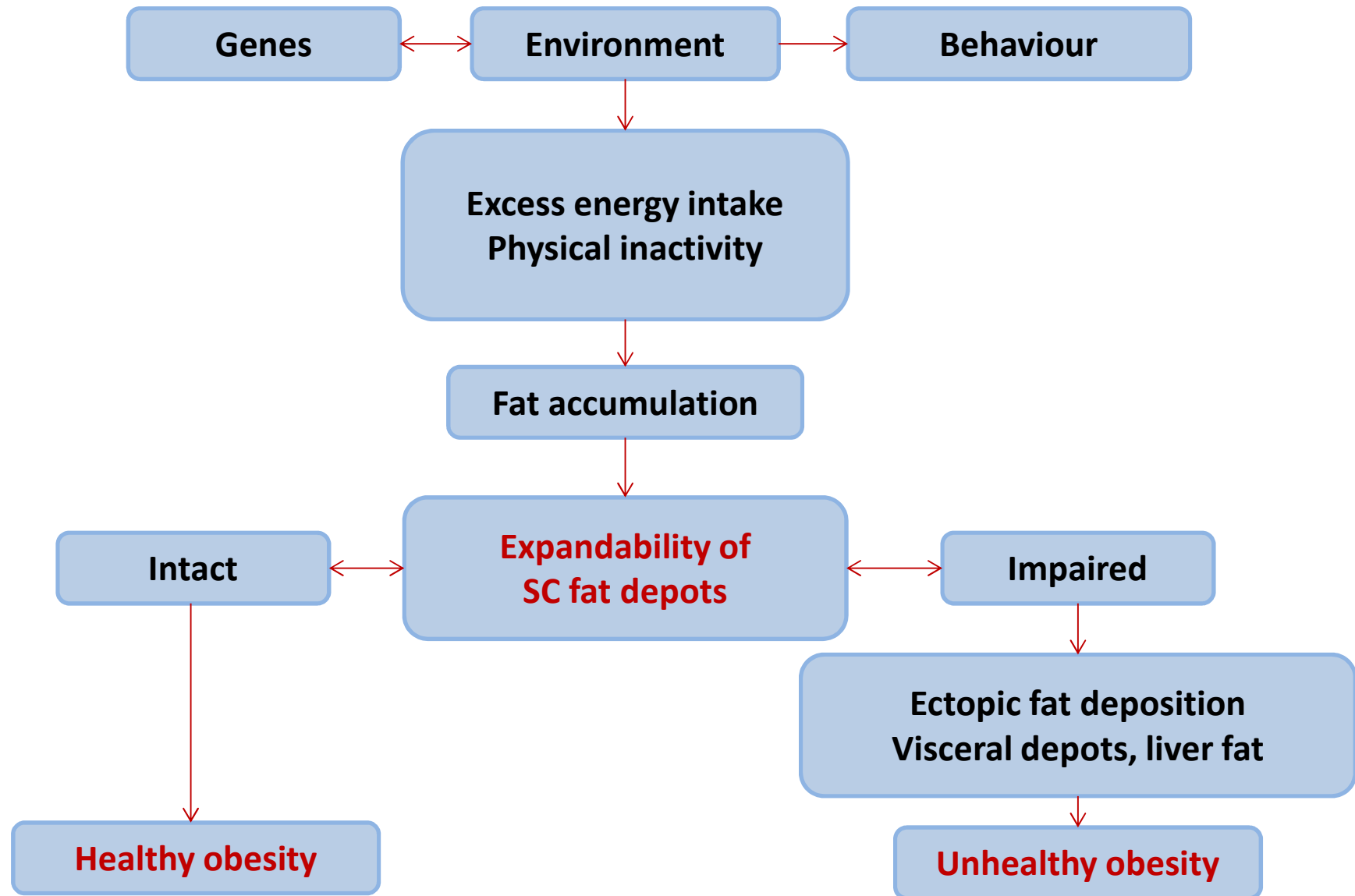
140 —



Potential Adipose Tissue-Related Mechanisms

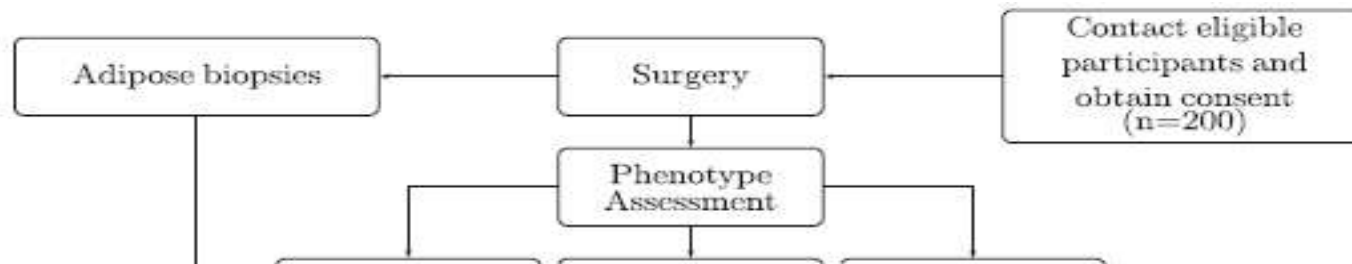


Potential Adipose Tissue-Related Mechanisms



Endocrinol Metab. 2014;29:427-434
Curr Opin Lipidol 2010;21:38-43.

Fat Expandability: Biomarker?



Summary 1

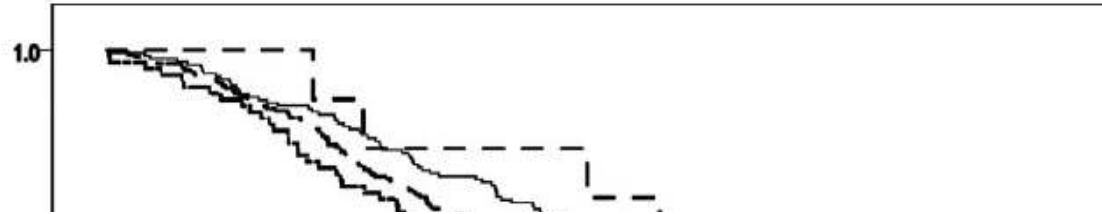
- Some obese subjects are insulin-sensitive, i.e., **metabolically**

• **metabolically**

Contents

- What is MHO?

MHO & Mortality: Pros (1)



- 15 yr f/up
- HOMA criteria (2.5)
- Italy

MHO & Mortality: Pros (2)

	Cases/n	Age- and sex-adjusted HR (95% CI)	Fully adjusted HR (95% CI) ^a
Whole sample			
Metabolically healthy nonobese	225/12716	1.00 (referent)	1.00

MHO & Mortality: Cons Definition Matters?



MHO & Mortality: Meta-analysis

C.

Study, Year (Reference)

Decrease All-Cause Mortality and/or CV Events Increase

Relative Risk (95% CI)

Weight, %

MHO

MHNO

Events/Participants, *n/N*

Events/Participants, *n/N*

Kip et al, 2004 (47)



0.29 (0.02–2.35)

0.55

1/77

6/132

Meigs et al, 2006 (8)



1.68 (1.17–2.19)

8.35

19/236

47/981

Song et al, 2007 (48)



1.22 (0.98–1.47)

26.77

77/2925

278/12 943

MHO & Atherosclerosis: Intermediate Profile



MHO & Atherosclerosis: Intermediate Profile

Nonobese
subjects

MHO

Insulin resistant
obese subjects

P^*

P^\dagger

P^\ddagger

MHO & Incident Type 2 Diabetes: Pros

Incident diabetes ($n = 112$)



MHO & Incident Type 2 Diabetes: Cons


A No ATP-III risk factors

B At least 3 ATP-III risk factors



MHO & DM: Meta-analysis

Study	Healthy obese (n)	Diabetes cases (n)	Follow-up (years)	RR (95% CI)
Miettinen et al. (2000) (2001)	600	7	2.8	2.40 (1.02, 5.60)



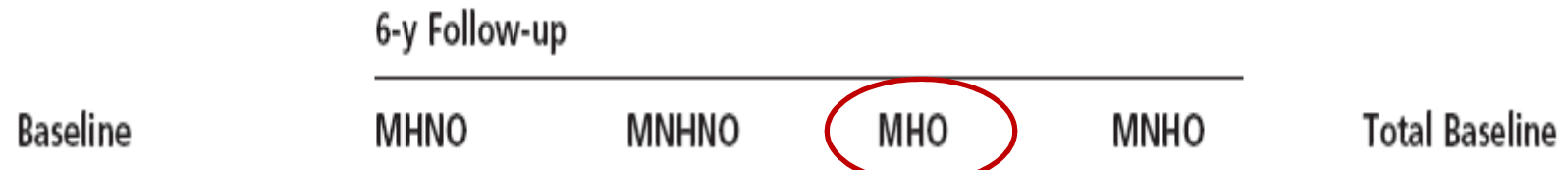
Obesity Phenotype: Dynamic Phenotype?



Predictors of MHO -> MUO

- 85 Japanese Americans with MHO (mean age 49.8 yrs)
- F/Un at 2 5 5 and 10 yrs

MHO & Outcomes: A Matter of Time?



Summary 2

- The **prognostic value of MHO** has been the subjects of much

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Contents

- What is MHO?

MHO & Subclinical Coronary Atherosclerosis

18 | P<0.01 with one-way ANOVA test | † | †
16 | | † | |

MHO & Subclinical Coronary Atherosclerosis



MHO & Subclinical Coronary Atherosclerosis

Table 3

Prevalence Ratios* for CAC by BMI Categories in 14,828 Metabolically-Healthy

MHO & Subclinical Coronary Atherosclerosis

☐ Stenosis
▣ CACS>0

P=0.260
P<0.001



MHO & Subclinical Coronary Atherosclerosis

(A)

Significant stenosis

MHNO



ORs (95% CI)

1.00 (Reference)

MUNO



1.38 (1.02-2.07)



(D)

Mixed plaque

MHNO



ORs (95% CI)

1.00 (Reference)

MUNO



1.33 (1.00-1.93)



MHO & Incident Type 2 Diabetes



MHO & Incident Type 2 Diabetes

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- MH Criteria: ≤ 1 of ATP III criteria (except WC)
- Incident Diabetes: FPG ≥ 126 mg/dl and/or HbA1c $\geq 6.5\%$
, antidiabetic medication (+)

MHO & Systemic Inflammation

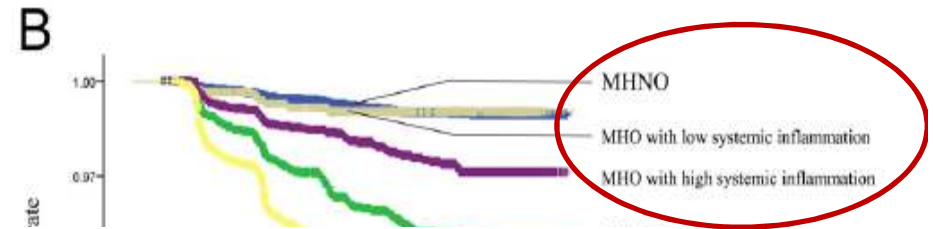
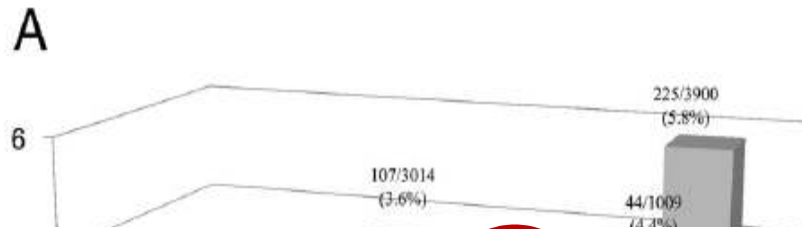
G_e¹²

**

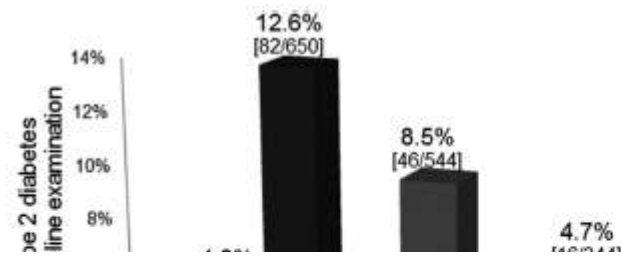
H₂O^{2.0}



MHO & Incident Type 2 Diabetes



MHO & Incident Type 2 Diabetes: Ectopic FAT



MHO & Incident CKD (P.109)



- MH Criteria: ≤ 1 of ATP III criteria (except WC)
- CKD definition: eGFR (CKD-EPI) < 60 ml/min/1.73m²

MHO & Incident CKD



MHO & Incident CKD: Strict MH Criteria



- MH Criteria: None of ATP III criteria (except WC)
- CKD definition: eGFR (CKD-EPI) < 60 ml/min/1.73m²

MUNO: Very harmful condition (Meta-analysis)

A.

Study, Year (Reference)

Decrease All-Cause Mortality Increase
← and/or CV Events →

Relative Risk
(95% CI)

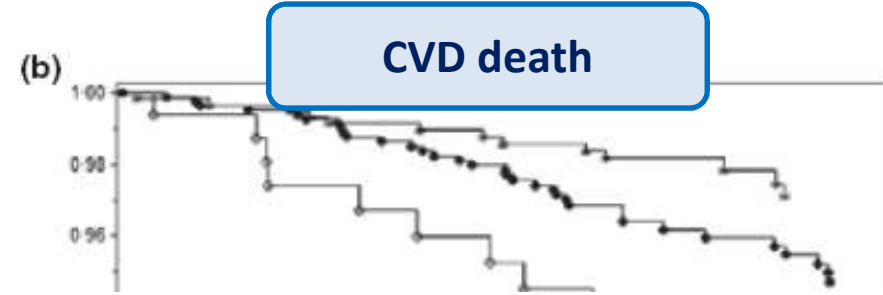
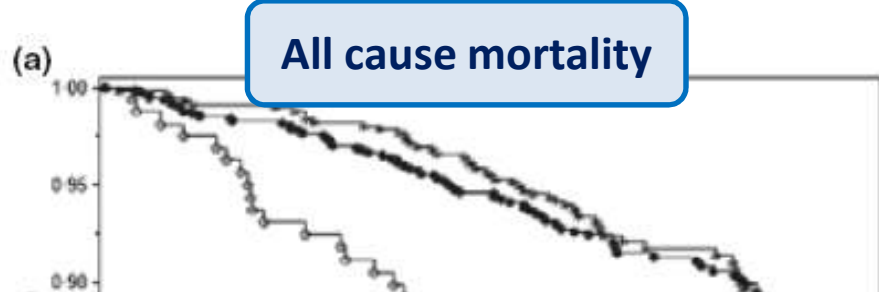
Weight of Evidence

MUNO

MHNO



MUNO: More harmful condition than MHO



Summary 3

- The association of **MHO and various health outcomes** seems to

▪



Conclusion

- Overall, **MHO** might **not** be a benign disease. In addition,

.. | | | | . . . | | | ..





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