

A brief history of the acid-ash hypothesis

- ▶ Early food composition studies (1907-1912)
 - Sherman et Gettler
- ▶ Food was burned to ash = minerals
- ▶ Simplistic categories → acid versus alkaline
- ▶ Now: Google: "acid ash diet" 2,800,000 hits
"alkaline diet" 900,000 hits
Many books & websites for the public

Books & Internet: Food classification: Milk

- ▶ 17% – Reference = Remer & Manz 1995
- ▶ 83% – No References: milk and cheese rated as slightly to very acidic.

Remer & Manz' well cited paper: JADA 1995

Potential renal acid load of foods and its influence on urine pH

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ABSTRACT

The purpose of this study was to calculate the potential renal acid load (PRAL) of selected, frequently consumed foods. A physiologically based calculation model was recently validated to predict an approximate estimate of renal net acid excretion (RAE); the model depends primarily on nutrient intake data. When nutrient data from actual food composition tables were used, the calculation model yielded PRAL values that ranged from an average maximum of 23.6 and 210.9 g for certain hard cheeses over 0.07 and 1.01 g for rice, and sets to an average minimum of approximately -2.0 and 13.9 g for milk and fruit juices and vegetables. By means of these PRAL data (summed according to the amount of food and beverages consumed daily) acid by an estimate of the net acid excretion (RAE) [based on body size], the daily RAE can be calculated. This calculation methodology, primarily based on PRAL, allows an approximate prediction of the effect of diet on the net acid excretion. The average net acid excretion of a diet consisting of a quart of milk, a slice of cheese, and a slice of bread was found to be approximately 10.0 g. The average net acid excretion of a diet consisting of a quart of milk, a slice of cheese, and a slice of bread was found to be approximately 10.0 g.

Remer's well cited paper re Acid:

- ▶ **Food:**
- ▶ **Potential renal acid load =**
 $PO_4 + SO_4 + Cl - Na - K - Ca - Mg$
- ▶ **Urine:**
- ▶ **Net acid excretion =** Titratable acid + NH_4^+ - HCO_3^-
- ▶ Ref: Remer & Manz 1995


Remer & Manz' food classification

Food	Potential acid load	
Meats (avg)	8.7	"Acid" producing
Vegetables (avg)	-3.6	"Alkali" producing
Milk	0.7	near neutral
Yogurt	1.5	near neutral
Camembert	14.6	A large serving
Parmesan	29.6	A large serving
Cheese, Gouda	18.6	A large serving

*per 100 grams

Next: 3 citations about milk, acid, and health

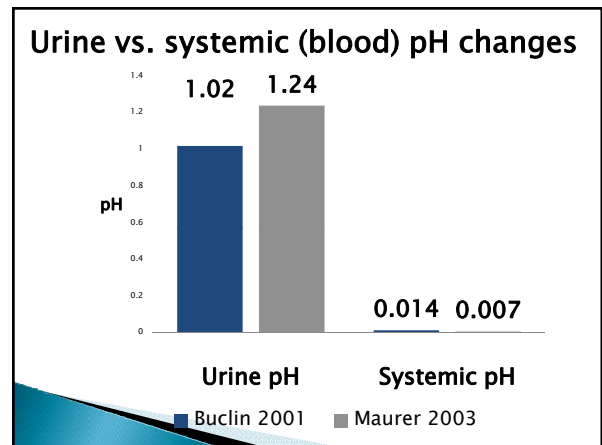
Does the evidence support these claims??



Citation #1: Produits laitiers... et d'acidification

▶ « La consommation excessive de viande... et de produits laitiers... est un facteur d'acidification de l'organisme particulièrement néfaste »

(Excessive consumption of meat and dairy products is a particularly harmful factor in acidification of the body)

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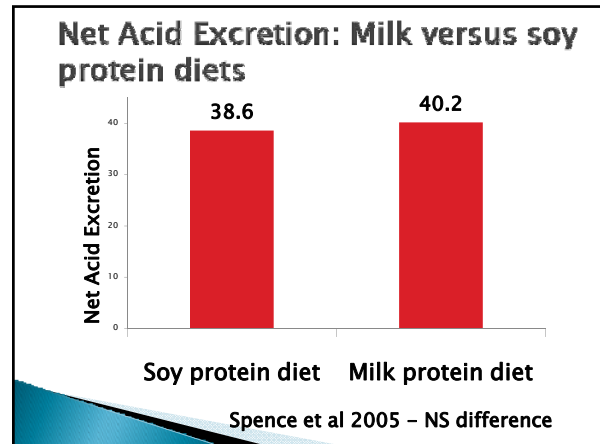
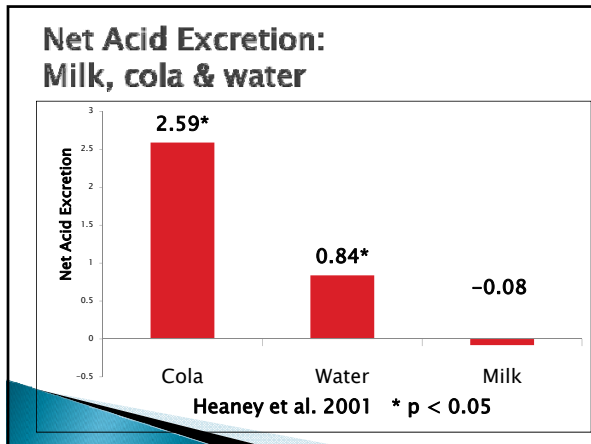
▶ Excessive consumption of meat and dairy products is a particularly harmful factor in acidification of the body



Citation #2: Dairy products: acid yielding and skeletal calcium depletion?

▶ "acid-yielding diets (most dairy products are acid yielding) cause urinary calcium loss [and] accelerated skeletal calcium depletion"

Konner et Eaton. Paleolithic nutrition: twenty-five years later. Nutr Clin Pract. 2010



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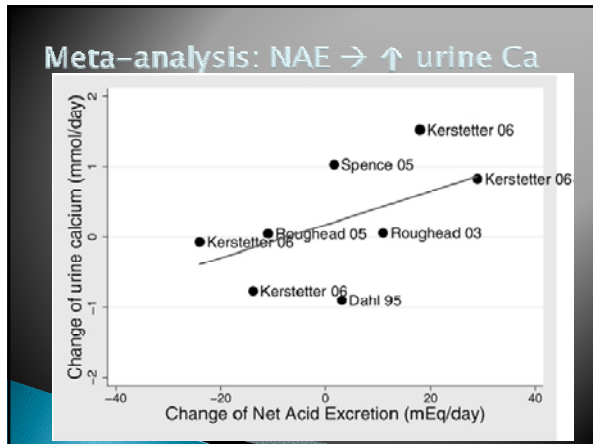
The evidence: Net acid excretion & Calcium metabolism:

- ▶ NAE → urine calcium ?
- ▶ NAE → calcium balance ?



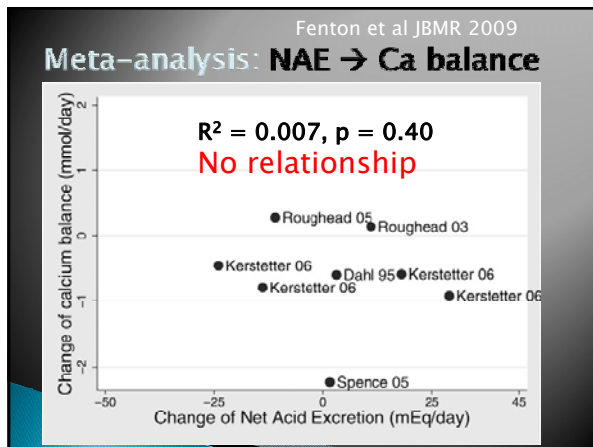
A systematic review of acid excretion and calcium metabolism:

- ▶ Inclusion criteria, limited to good methodological quality :
 - Randomized
 - Followed recommended practices for calcium balance studies (Institute of Medicine 1997)
- ▶ → 7 comparisons in 5 studies, n = 108
- ▶ Fenton et al. J Bone Miner Res 2009;24:1835–40



Calcium balance is a better measure of Ca status than urinary calcium

- ▶ Calcium balance =
- ▶ Ca intake – (urine Ca + fecal Ca)
- ▶ If **negative**, then Ca is being lost
- ▶ If **positive**, then Ca is being retained



In summary - Net acid excretion in relation to Calcium metabolism, studies with superior methodology :

- ▶ NAE → ↑ urine calcium

But ...

- ▶ NAE → **no change** in calcium balance
- ▶ *Ca balance is a superior measure*

Citation #1: milk or dairy

- ▶ “acid-yielding diets (most dairy products are acid yielding) cause urinary calcium loss [and] accelerated skeletal calcium depletion”

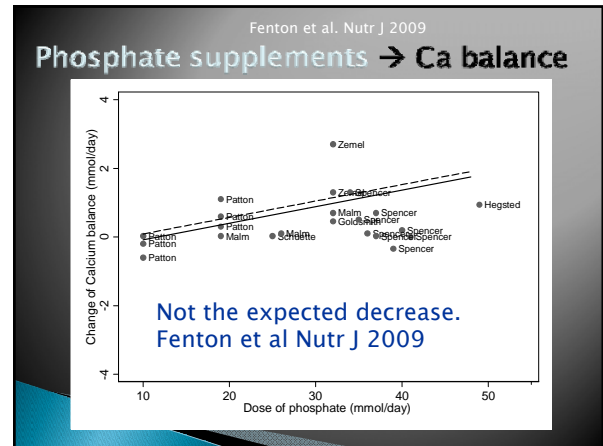
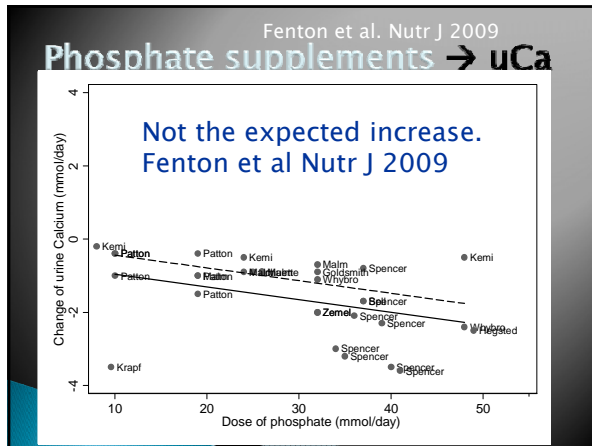
Konner/Eaton 2010

→ Only the uCa part is supported by the evidence

Remer’s calculation of diet acid

- ▶ Diet acid = milliequivalents:
- ▶ $PO_4 + SO_4 + Cl - Na - K - Ca - Mg$.

Importance??



Summary

- Acid excretion and phosphate are not associated with loss of whole body calcium.
- These findings are contrary to the acid ash hypothesis
- Therefore, Remer's food classification system that defines dairy products as slightly acid producing is not relevant to bone health.

Remer' food classification: Omit P

Food	PRAL	Omit P	
Meats (avg)	8.7	1.4	"Acid" producing
Vegetables	-3.6	-6.3	"Alkali" producing
Milk	0.7	-2.7	"Alkali"
Yogurt	1.5	-4.7	"Alkali"
Camembert	14.6	-22	"Alkali"
Parmesan	29.6	4.6	A large serving
Gouda	18.6	0.7	near neutral

*per 100 grams

Citation #3: milk or dairy → fx?

- "osteoporotic bone fracture rates are highest in countries that consume the most dairy, calcium, and animal protein" Lanou et al. Should dairy be recommended as part of a healthy vegetarian diet? Am J Clin Nutr 2009

Citation #3: milk or dairy → fx?

- "osteoporotic bone fracture rates are highest in countries that consume the most dairy, calcium, and animal protein" Lanou et al. 2009
- This is an ecologic fallacy:** "bias that may occur because an association observed between variables on an aggregate level does not necessarily represent the association that exists at an individual level"
- Ref: Last JM 2001 *A Dictionary of Epidemiology*

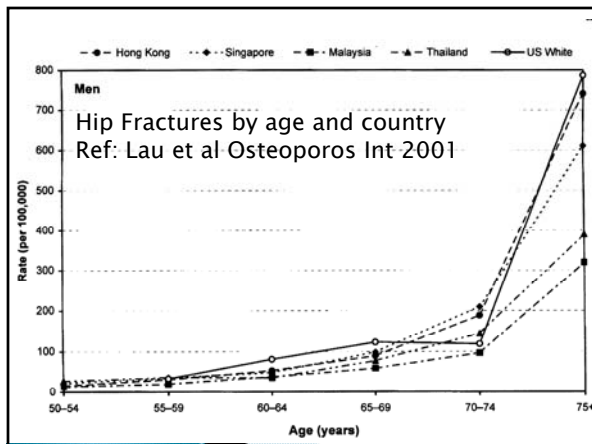
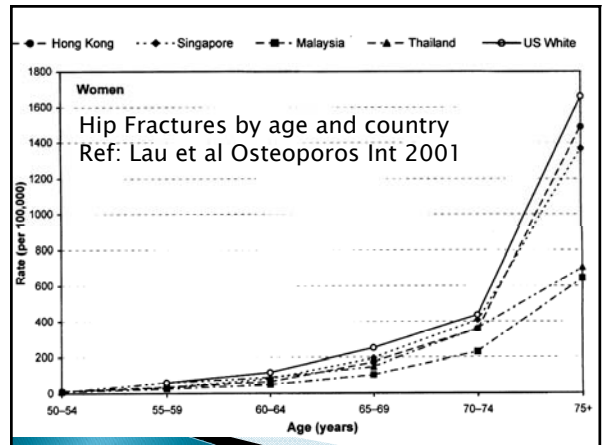
The problem with comparing Asian and western fracture rates:

- ▶ There are several differences between cultures as well as the quantity of milk consumption
- ▶ 1. Physical activity



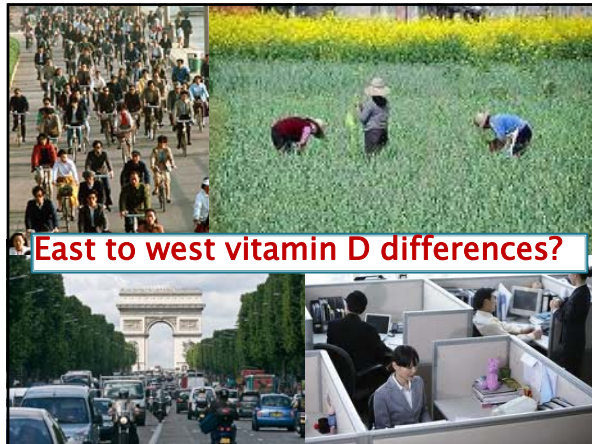
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- ▶ There are several differences between cultures as well as the quantity of milk consumption
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- ▶ 2. Fracture rates do not differ: urban vs. urban



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- ▶ There are several differences between cultures as well as the quantity of milk consumption
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- ▶ 3. Vitamin D status?



East to west vitamin D differences?

The problem with comparing Asian and western fracture rates:

- ▶ There are several differences between cultures, as well as the quantity of milk consumption
- ▶ 1. Physical activity
- ▶ 2. Fracture rates do not differ: Asian urban vs. Western urban
- ▶ 3. Vitamin D status?
- ▶ 4. Numerous other diet differences
- ▶ 5. Genetics
- ▶ 6. Height (risk factor for hip fractures)

Citation #3: milk or dairy → fx?

▶ *“osteoporotic bone fracture rates are highest in countries that consume the most dairy, calcium, and animal protein”* Lanou et al. Should dairy be recommended as part of a healthy vegetarian diet? Am J Clin Nutr 2009

Conclusion

- ▶ Diet does not change systemic pH or cause or “acidification”
- ▶ Milk does not produce acid upon metabolism
- ▶ Better quality evidence reveals that acid excretion is not associated with lower calcium balance, that is: poorer calcium balance
- ▶ Evidence does not support associations between milk with osteoporosis in the west vs. Asia once physical activity is considered.
- ▶ It is not correct to compare between cultures that have many differences

Just published:

Causal assessment of dietary acid load and bone disease: A systematic review and meta-analysis applying Hill's epidemiologic criteria for causality

Nutrition Journal 2011, 10:41
 Fenton TR, Tough SC, Lyon AW, Eliasziw M, Hanley DA.



Merci beaucoup