

# Dietary Approaches to Lower Blood Pressure

Matthew R. Weir, MD  
Professor and Director  
Division of Nephrology  
University of Maryland School of Medicine

## Disclosures

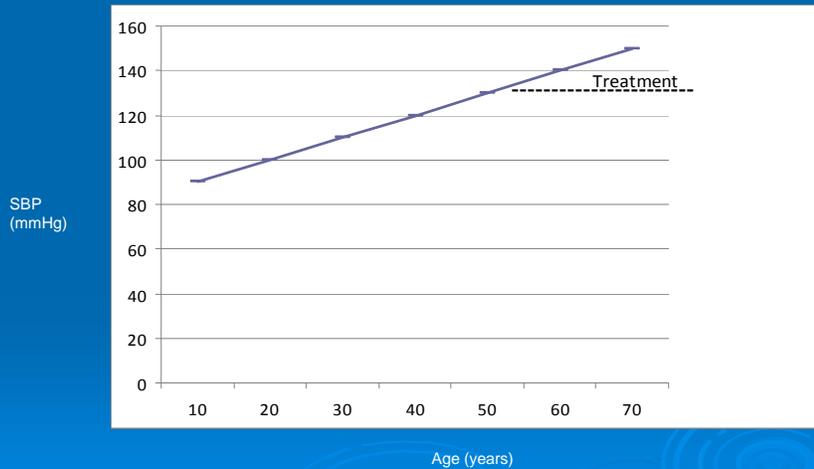
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- No other disclosures.

## Overview

- Perspective of age, genes, and blood pressure
- Evaluation of the effect and impact of dietary approaches to reduce blood pressure
- Dietary approaches with evidence of benefit:
  - Reduce salt intake
  - Increase potassium intake
  - Weight loss
  - Moderation of alcohol intake
  - DASH style diet
  - Moderation of sugar-sweetened beverages
- Conclusions

## Perspective of Age, Genes, and Blood pressure

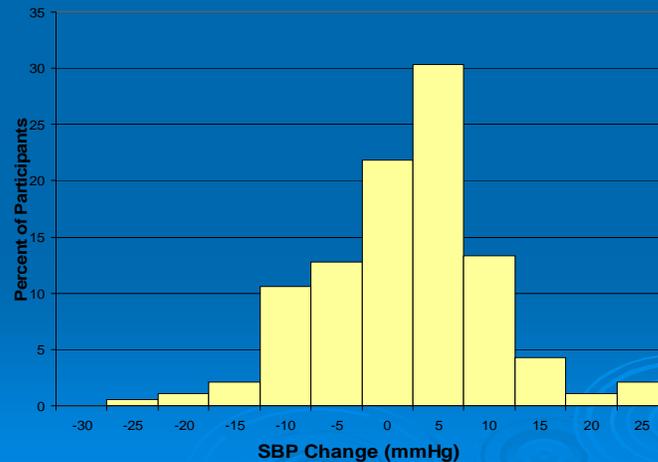
- Age and gene-related increases in blood pressure provide a slope of change over time.
- This can be modified with non-pharmacologic or pharmacologic approaches.
- Earlier in life, dietary modification may prevent or delay the development of higher levels of blood pressure.
- Later in life, dietary modification may delay requirement for pharmacologic treatment, or reduce the amount of medication required to reach ideal blood pressure goals.



## Evaluation of the effect and impact of dietary approaches to lower blood pressure

- Net impact of treatment can vary substantially within a population, depending on age, genes, and level of pre-intervention blood pressure.
- Mean changes of blood pressure are crude estimates of change, as often it represents the spectrum of those who go up, those who do not change, those who go down, and random variation.
- A more realistic statistic may be the percentage who change by a pre-determined amount in response to a dietary intervention.

## Differences in Systolic BP Between Two Periods (No Sodium difference)



Obarzanek, Hypertension 2003;42:459

## Dietary Approaches with Evidence of Benefit

- Reduced dietary salt intake
- Increased dietary potassium intake
- Weight loss
- Moderation of alcohol intake
- Increased ratio of vegetable to animal protein intake
- Moderation of sugar-sweetened beverages intake

## Reduced Dietary Salt Intake

- The blood pressure response to changes in dietary salt is heterogenous due to genetic and dietary factors which influence the blood pressure response to sodium.
- Middle-aged and older patients and Blacks are more likely to have blood pressure increases in response to salt. Yet, increasing dietary potassium or vegetable protein intake may blunt the pressor effects of dietary salt.
- This considerable overlap in response and lack of a clinic test to indicate blood pressure salt sensitivity limits the clinical opportunity to tailor recommendations about salt intake, other than universal moderation of salt intake.



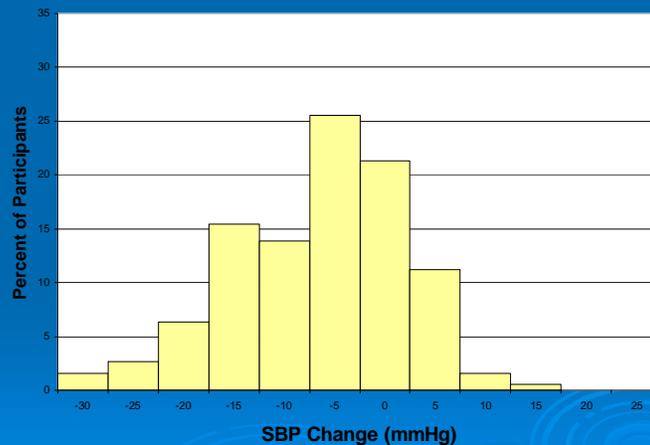
## Reduced Salt Intake

- More than 50 short-term trials
- Meta-analysis in adults: for a 78 mmol/day reduction (1.8g) of dietary sodium, BP decreased by 5.0/2.7 mmHg in hypertensives and 2.0/1.0 mmHg in non-hypertensives
- Meta-analysis in children: sodium reduction reduction by BP 1.2/1.3 mmHg

HeFJ, MacGregor GA. J Human Hypertens 2002; 16:761-770

HeFJ, MacGregor GA. Hypertension 2006;48:861-869

## Difference in SBP Between Higher and Lower Na Intake (contrast of ~70 mmol/d)



Obarzanek, Hypertension 2003;42:459

## Reduced Salt Intake

- Prevents hypertension by approximately 20%
- Improves hypertension control
- Blunts age-related rise of BP
- Lowers BP with antihypertensive medications

Trials of Hypertension Prevention Collaborative Research Group. Arch Intern Med 1997;157:657-667  
Tone Collaborative Research JAMA 1998;279:839-846  
Intersalt Research Group BMJ 1988;297:319-328  
Weir MR et al. Hypertension 1997;30: 422-427

## Reduced Salt Intake

- Reduced salt intake (with or without higher potassium intake reduces CV events by 21 to 41% in 2 trials.
- Reduced salt intake showed a trend towards fewer CV events in the elderly.

Chang HY et al. Am J Clin Nutr 2006;83:1289-1296

Cook NR et al. BMJ 2007;334:885-891.

Appel LJ, et al. Arch Intern Med 2001;685-693.

## Reduced Salt Intake

- No evidence of adverse outcomes, despite theoretical concerns about increasing PRA, neurohormones, etc!
- Is there clinical evidence that sufficient salt restriction is possible to adversely effect neurohormonal profile and CV outcome?

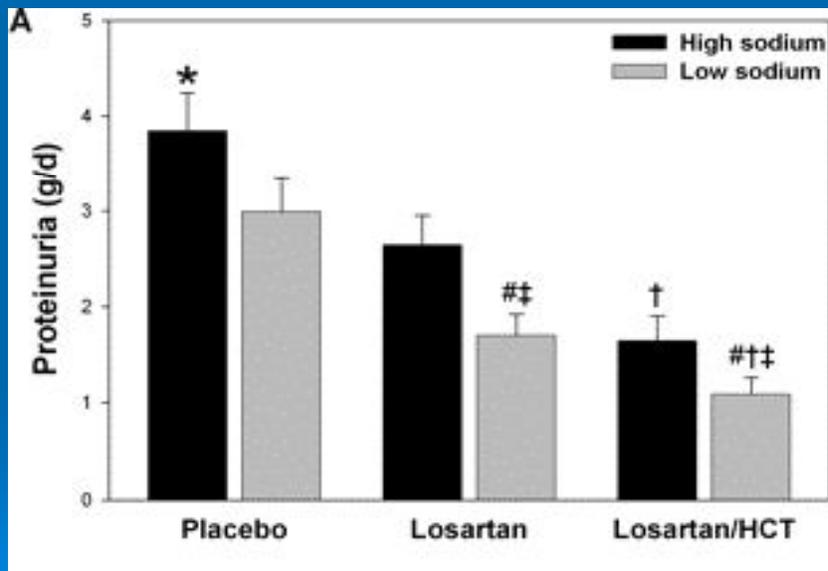
**NO!**

## Reduced Salt Intake Recommendations

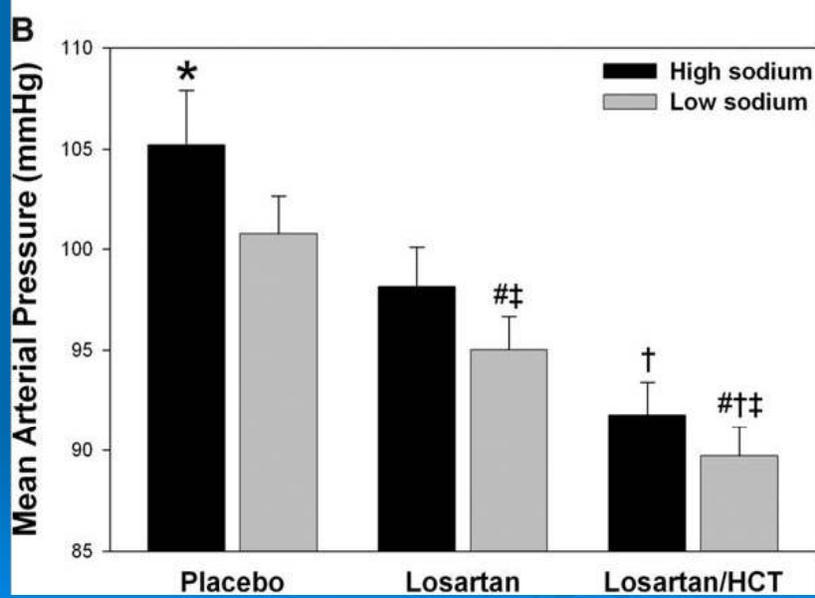
- General Population: 2300 mg/day sodium
- Blacks, Middle-aged and older, diabetes, or CKD: 1500 mg/day sodium
- Current intake (1988-1994)
  - Children: 3100-3700 mg/day sodium
  - Adults: 2900-4300 mg/day sodium
- Most effective strategy: limit intake of processed food. About 80% of daily dietary salt occurs from processed food. Only about 10% comes from adding salt in cooking or the table.

## Effect of Low Salt Diet and Diuretic Therapy on the Antiproteinuric Effect of AT<sub>1</sub> Blockers

- 34 non-diabetic proteinuric patients
- Baseline  $3.8 \pm 0.4$  g/day
- Low salt = 90 mmol/day
- High salt = 200 mmol/day
- Creat clearance = 90 ml/min
- BP = 143/86 mmHg



Vogt, L. et al. J Am Soc Nephrol 2008;19:999-1007



Vogt, L. et al. J Am Soc Nephrol 2008;19:999-1007

## Increased Potassium Intake

- Three meta-analysis have documented that increased potassium intake lowers BP in both hypertensives and non-hypertensives
- Higher potassium intake reduces BP to a greater degree in Blacks than Whites
- One study demonstrated that a net increase of urinary potassium of 50 mmol/day reduced BP:  
4.4/2.5 mmHg in hypertensives  
1.8/1.0 mmHg in normotensives



Cappuccio FP, MaGregor GA. J Hypertens 1991; 9:45-473  
Whelton PK, et al. JAMA 1997; 277: 1624-1632  
Geleijnse JM, et al. J Human Hypertens 2003; 17: 471-480

## Increased Potassium Intake

- The extent of BP reduction with potassium ingestion depends on the current salt intake. More salt intake, more BP reduction with potassium.
- Sub-additive effects of reduced salt intake and increased potassium intake.
- Recommendations for dietary potassium are lacking because of no dose-response trials.
- Institute of Medicine recommends 120 mmol/day (4.7g).

## Increased Potassium Intake

- Not a concern in healthy people with normal kidney function
- Likely easier to do than salt restriction
- More of a concern in patients with CKD (but conceivably could be a very helpful and safe strategy)
- Caution with patients taking NSAIDs, RAS blocking drugs, and K<sup>+</sup> sparing diuretics

## Increased Potassium Intake

- NHANES III data:
  - Adult men: 74-82 mmol/day
  - Adult women: 54-59 mmol/day

Note: only 10% of men and 1% of women eat 120 mmol/day!

## Increased Potassium Intake

- Mechanisms of benefit on BP lowering is unknown
  - ? Vegetable protein
  - ? Bicarbonate precursors
  - ? Other nutrients

## Weight Loss

- Weight is directly associated with BP
- More obesity results in higher BP
- This trend is most evident in children
- Weight loss is associated with reduction of BP, even if not to an ideal body weight.



## Weight Loss

- One meta-analysis demonstrated that with a 5.1 kg weight loss resulted in a mean BP reduction of 4.4/3.6 mmHg
- More weight loss, more BP reduction
- Modest weight loss can prevent hypertension by 20% in pre-hypertensives, and can help with BP medication reduction or withdrawal
- Main long-term issue: keeping the weight off!

Neter JE et al. Hypertension 2003;42:878-884

TOHP Collaborative Research Group Arch Intern Med 1993;153:849-858

Trials of Hypertension Prevention Collaborative Research Group. Arch Intern Med 1997;157:657-667

## Moderation of Alcohol Intake

- Observational studies demonstrate a dose-response with alcohol and BP above 2 drinks/day
- A meta-analysis of 15 trials, demonstrated that decreased consumption of alcohol by 76% (range 16-100%) lowered BP 3.3/2.0 mmHg in both hypertensives and non-hypertensives
- Some have suggested that alcohol can affect BP even in the light range (1-2 drinks/day). However, this range may also be cardioprotective



Klatsky AL et al. NEJM 1977;296:1194-1200

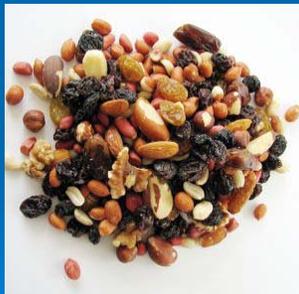
Xin X, et al. Hypertension 2001; 38:1112-1117.

## Moderation of Alcohol Intake

- Moderation is advised:
  - Males: no more than 2 drinks/day
  - Females: no more than 1 drink/day

## DASH Style Diet

- Vegetarian diets are associated with reduced BP
- Observational studies show that vegetarians have a blunted rise of BP with age.
- Both dietary and non-dietary factors may reduce BP
- Other aspects of the diet in vegetarians may lower BP besides increased vegetable protein



Sacks FM, et al. Am J Epidemiol 1974;100:390-398  
Sacks FM, Kass EH. Am J Clin Nutr 1988;48:795-800

## DASH Style Diet

- DASH diet/variants: rich in potassium, magnesium, calcium, fiber; reduced total fat, saturated fat and cholesterol; increased vegetable protein
- Many potential BP lowering effects: net result is 5.5/3.0 mmHg
- Effective in all major groups: age, gender, ethnicity, hypertensive or not
- Most effective in Blacks: 6.9/3.7 mmHg and hypertensives; 11.6/5.3 mmHg
- DASH diet lowers BP with different levels of salt intake

Karanja NM et al. J Am Diet Assoc 1999;99:519-527  
Svetkey LP, et al. Arch Intern Med 1999;159:285-293

## DASH Style Diet

- OmniHeart Trial compared 3 variants of DASH
  - Rich in carbohydrate (58% of calories)
  - Rich in vegetable protein (50%)
  - Rich in monounsaturated fat
- Each diet lowered BP, but substituting carbohydrate with vegetable protein or monounsaturated fat further reduced BP
- A diet associated with increased net acid load (animal protein) is associated with increased risk of incident hypertension in nurses (after controlling for all other dietary factors)

Appel LJ, et al. JAMA 2005;294:2455-2464  
Zhang L, et al. Hypertension 2009; 54:751-755

## DASH Style Diet

- Safe, except perhaps in patients with CKD (high in potassium, phosphorus, protein)
- Total protein intake in US is above recommended levels, with more animal than vegetable protein
- With a nutrient-dense diet, plant foods can supply a sufficient amount of amino acids, than can supply alkali and reduce net acid load.

### Modification of Sugar-Sweetened Beverages Intake

- Reduction of one sugar-sweetened beverage (SSB)/day resulted in a 1.8/1.1 mmHg reduction in BP over 18 months in a prospective study of 810 adults
- Cross-sectional studies demonstrate a positive association between SSB consumption and BP
- A cross-sectional study of NHANES (2003-2006) demonstrated that increased fructose intake (>74g/day about 2.5 SSB/day) was independently, and significantly associated with greater odds of elevated BP, and a 30% greater risk for BP above 140/90 mmHg



Chen et al. Circulation 2010; 121: 2398-2406  
Winkelmayer WC, et al. JAMA 2005; 294: 2330-2335  
Dhingra R, et al. Circulation 2007; 116: 480-488

## Modification of Sugar-Sweetened Beverages

- Mechanism of increased BP is unknown
- Possibilities include:
  - Weight gain
  - Increased SNS stimulation from sugars
  - Reduced salt excretion
  - Increased fructose causing increased uric acid with vascular injury

## Dietary Approaches Without Sufficient Evidence to support routine use

- Fiber
- Fish Oil
- Calcium
- Magnesium
- Carbohydrate
- Cholesterol
- Vitamin C

## Recommendation Based on the Literature

- Reduced salt intake
- Increased potassium intake
- Weight loss
- Moderation of alcohol consumption
- DASH-style diet
- Moderation of sugar sweetened beverages

## Perspective

- Better to eat fresh food high in nutrients and vegetable protein
- This food is more expensive, takes longer to prepare, and needs to be properly seasoned to enhance taste.

# Problem



Fast, cheap, tastes good!