Nutrition and Chronic Kidney Disease:
Designing Diets for a Complex Population

June Martin, RD, CDE
Grand River Hospital, Kitchener, ON

Disclosures:
Unrestricted educational grants: Shire, Amgen, Abbot
Honoraria: Genzyme

Introduction

- Nutritional management in renal disease plays a role in all stages of CKD and evolves as the disease changes
- Diet is complex and at times conflicts with other nutrition recommendations
- Diet plays a role in preventing progression of CKD as well as preventing and managing complications

What is the renal diet?

- No standard renal diet
- Requires individual assessment
- Depends on:
  - Stage
  - Modality of RRT
  - Medications
  - Comorbidities (diabetes, celiac, cardiac)
  - Labs
  - Lifestyle

Burden of the Renal Diet

- Patients' perspective of renal diet:
  - Complex and confusing
  - Isolating
  - Perceived as unhealthy and perhaps causing other problems
  - Conflicting messages

Tong, A et al *Am J Kidney Dis* 2009 53:689-700

Renal Diet Components

- Sodium
- Protein
- Phosphorus
- Potassium
- Fluid
- Any other therapeutic diet considerations

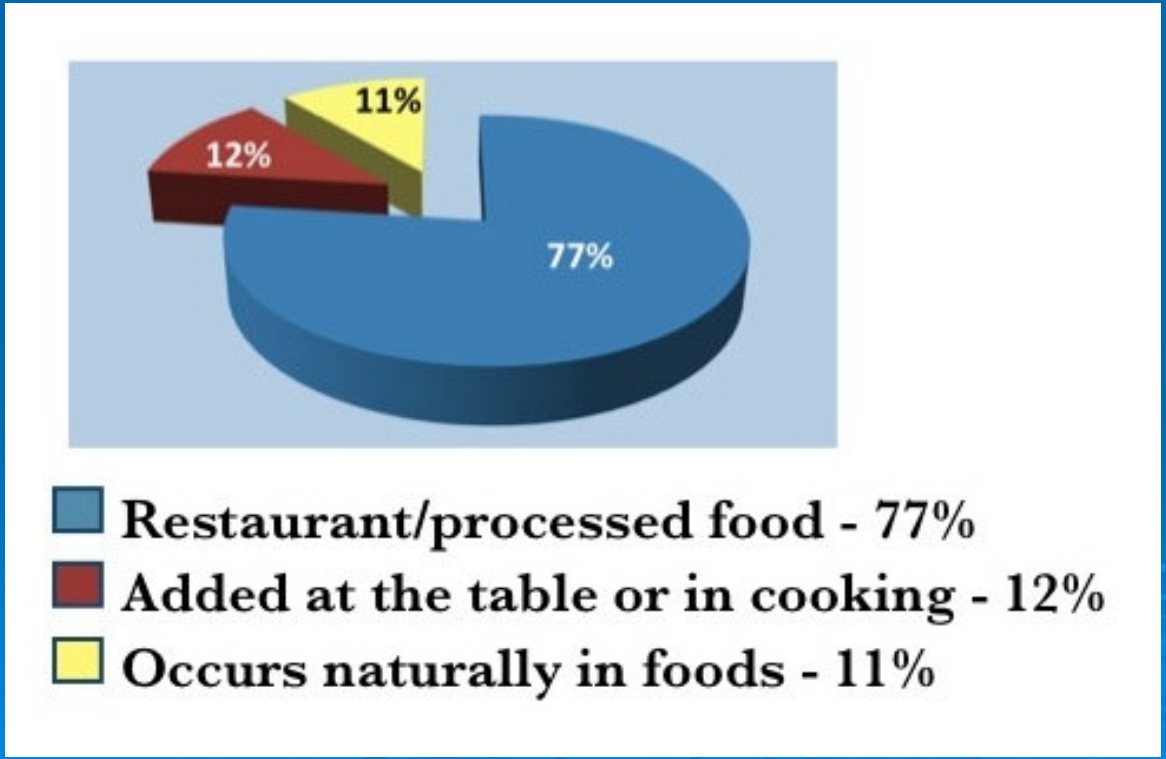
Goal should be ONE diet!

Sodium

- Guidelines consistent with most other chronic disease guidelines
- Low sodium guidelines do not change as the disease progresses

Sodium

Most people perceive their diet as low in salt as long as they don't add salt at the table



Source: Hypertension Canada

Sodium

- Considered the cornerstone of public health initiatives to reduce blood pressure
- Based on Cochrane Review a reduction in average dietary sodium intake by 1800 mg/d (from 3500 mg to 1700 mg in Canada) would result in:

  - 1 million fewer hypertensive Canadians
  - Almost double the BP treatment and control rate
  - Hypertension care cost savings of $430 to 538 million /yr

Can J Cardiol 2007;23:437-443

Impact of Lifestyle Therapies on Blood Pressure in Hypertensive Adults

Intervention	Intervention	SBP/DBP
Reduce sodium intake	-1800 mg/day sodium Hypertensive	-5.1 / -2.7
Weight loss	per kg lost	-1.1 / -0.9
Alcohol intake	-3.6 drinks/day	-3.9 / -2.4
Aerobic exercise	120-150 min/week	-4.9 / -3.7
Dietary patterns	DASH diet Hypertensive	-11.4 / -5.5

Padwal R. et al. CMAJ SEPT. 27, 2005; 173 (7) 749-751

Treatment Study: DASH Sodium

Randomized 412 adults (mixed B.P. status, racial groups, sexes) to:

- Control diet - low in fruit, veg and dairy, fat content typical of US
- DASH diet - high in fruit, veg and low-fat dairy, reduced fat content
- Consume diet for consecutive 30 day periods in random order at each of 3 levels of salt

Intervention	*Change in mean B.P. vs. control (systolic)*	
	Control diet	*DASH diet*
9g/d salt	Control level	- 6 mmHg
6g/d salt	- 2 mmHg	- 7 mmHg
3g/d salt	- 7 mmHg	- 9 mmHg

Sacks et al. NEJM 2001; 344:3-10

Sodium

- Across all stages of CKD
- Early in CKD and for prevention– DASH diet
- Hemodialysis – fluid restriction cannot be achieved without limiting sodium
- Dialysis – goal is to achieve euvolemia
  - Volume overload leads to CHF, LVH and HTN

Protein in CKD

- Stages 3-5
  - Goal is to slow progression and decrease uremic load
  - Improved proteinuria in nephrotic patients
  - Phosphate control
  - Low protein diet(0.6-0.8g/kg IBW/d) vs very low protein diet(0.3g/kg IBW/d +aa)

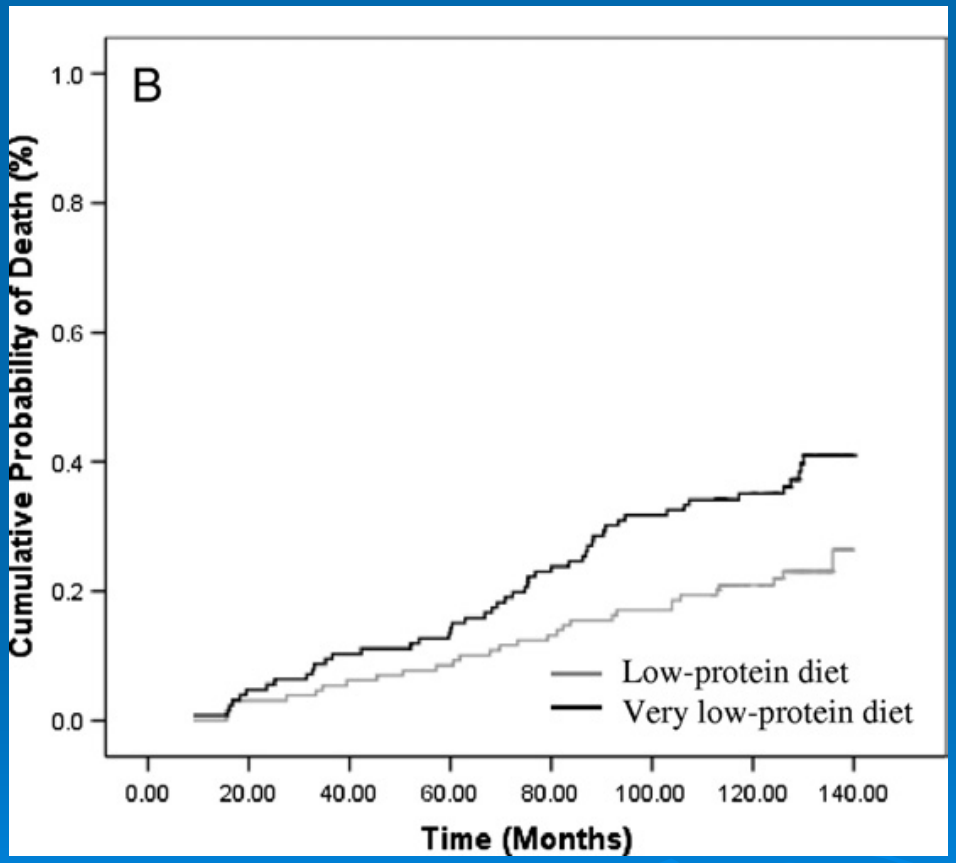
Protein in Diabetic Nephropathy

- Modestly slows progression (non-significant)
- Estimated delay to dialysis of 1-2months
- Small average benefit may conceal larger benefit for some patients

- Impact on Practice: Pragmatic to reduce to max of 1g/kg/d or prescribe 0.8g/kg/d where reasonable and in the absence of malnutrition

Robertson LM et al. *Cochrane Database of Systematic Reviews* 2007, Issue 4.

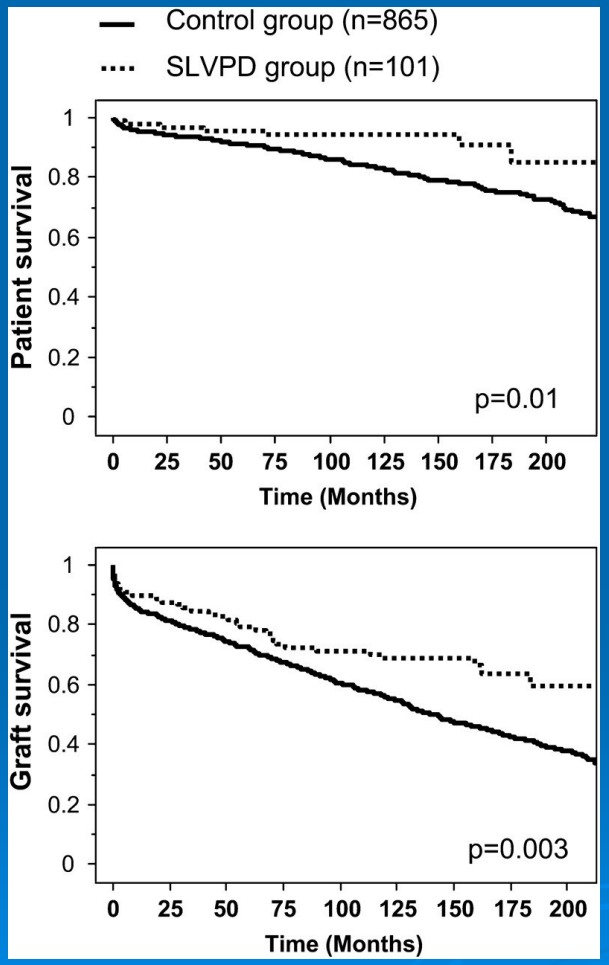
Outcomes on Very Low Protein Diet



- MDRD 15yr follow-up
- Low protein did not prevent progression but did increase risk of death
- Lack of follow-up after completion of study

Menon V. et al Am J Kid Disease 2009;53:208-217

Outcomes on Very Low Protein Diet



- No detrimental effect of very low protein diet was observed
- Patients were closely monitored and supported
- Highly motivated patient group

Chauveau P et al. Am J Clin Nutr 2009;90:969-974

Protein Restriction

- Some evidence that a low protein diet may benefit some patients

BUT:

- Need adequate calories
- High biologic value protein
- Treat metabolic acidosis

Levey, A et al. J Am Soc Nephrol 1999; 10: 2426-2439
Robertson LM et al. *Cochrane Database of Systematic Reviews* 2007, Issue 4
Mitch, W. J Am Soc Nephrol 1991; 2:823

Protein Restriction

- Benefit in preventing progression is modest
- Risk of malnutrition is significant if no adequate follow-up
- Requires motivated patients and adequate support

48% of patients with chronic kidney disease (CKD) are malnourished before starting dialysis therapy

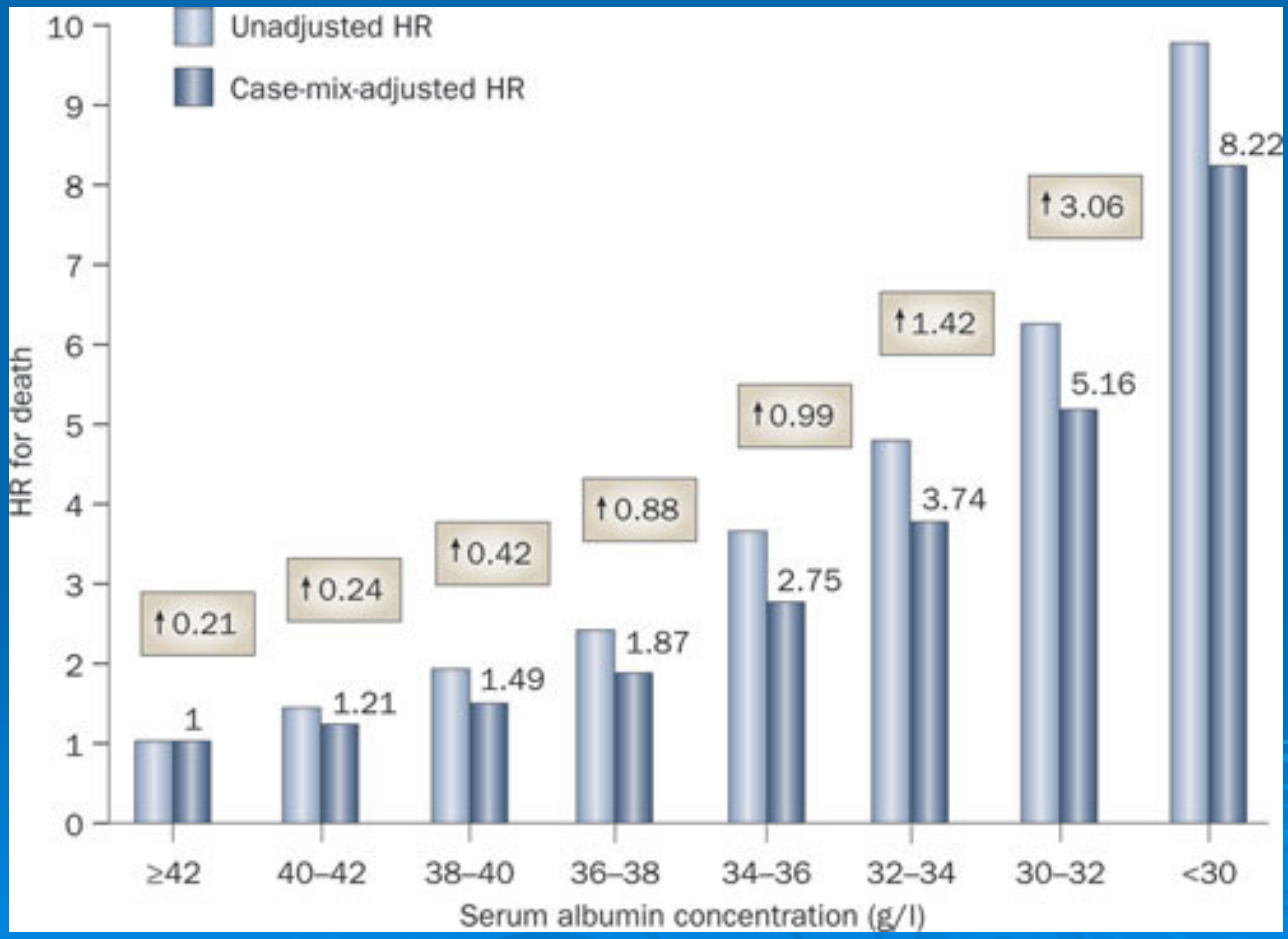
Am J Kidney Dis 2000 (36), 1213-25

Protein in Dialysis

- Hemodialysis – 1 -1.2g/kg/d
- PD – 1.2-1.3g/kg/d
- Prevalence of malnutrition estimated to be as high as 18-75% of dialysis
- Goal is to prevent malnutrition and replace losses

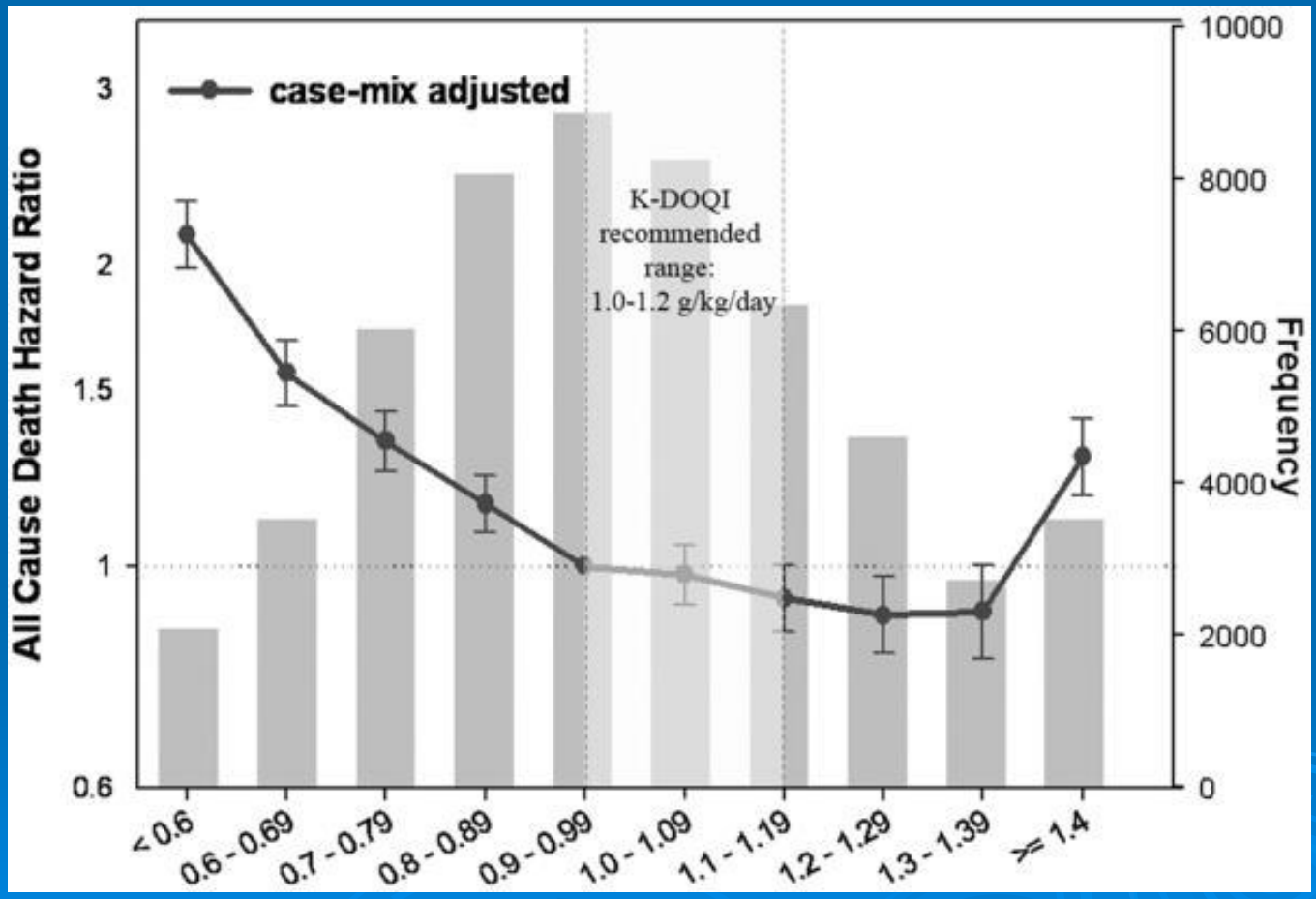
Kidney Int. 2008 (73), 391-398.

Serum Albumin and Survival on Dialysis



Kalantar-Zadeh, K. *et al.* 2011 *Nat. Rev. Nephrol.* doi:10.1038/nrneph.2011.60

Survival and Protein Intake



Shinaberger, C et al. *Am J Kidney Dis 2006* 48:37-49

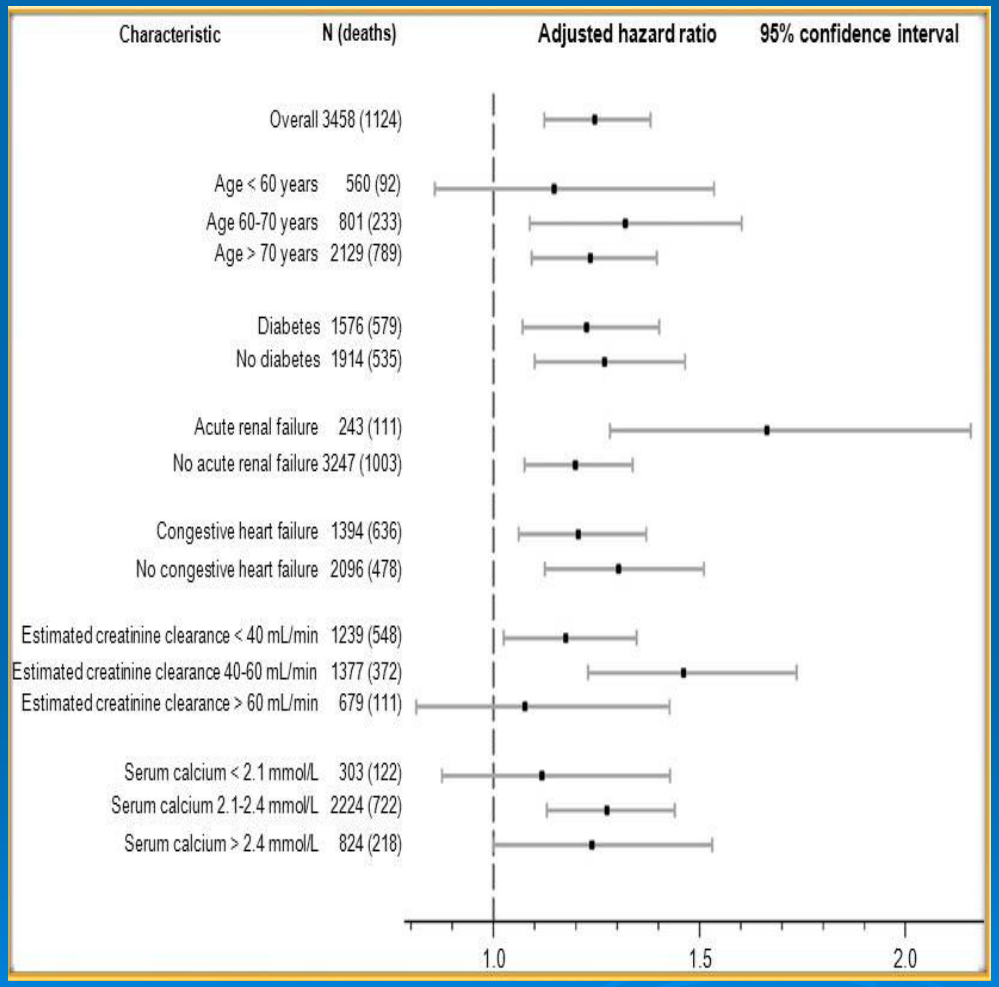
Protein in Dialysis

- Patients report aversion to meat and protein foods
- PD patients often complain of fullness
- Fatigued
- Limited financial and social resources

Phosphorus

- Independent risk factor for morbidity and mortality
- Process begins early in CKD before serum phosphorus rises
- Progressive

Phosphorus in CKD

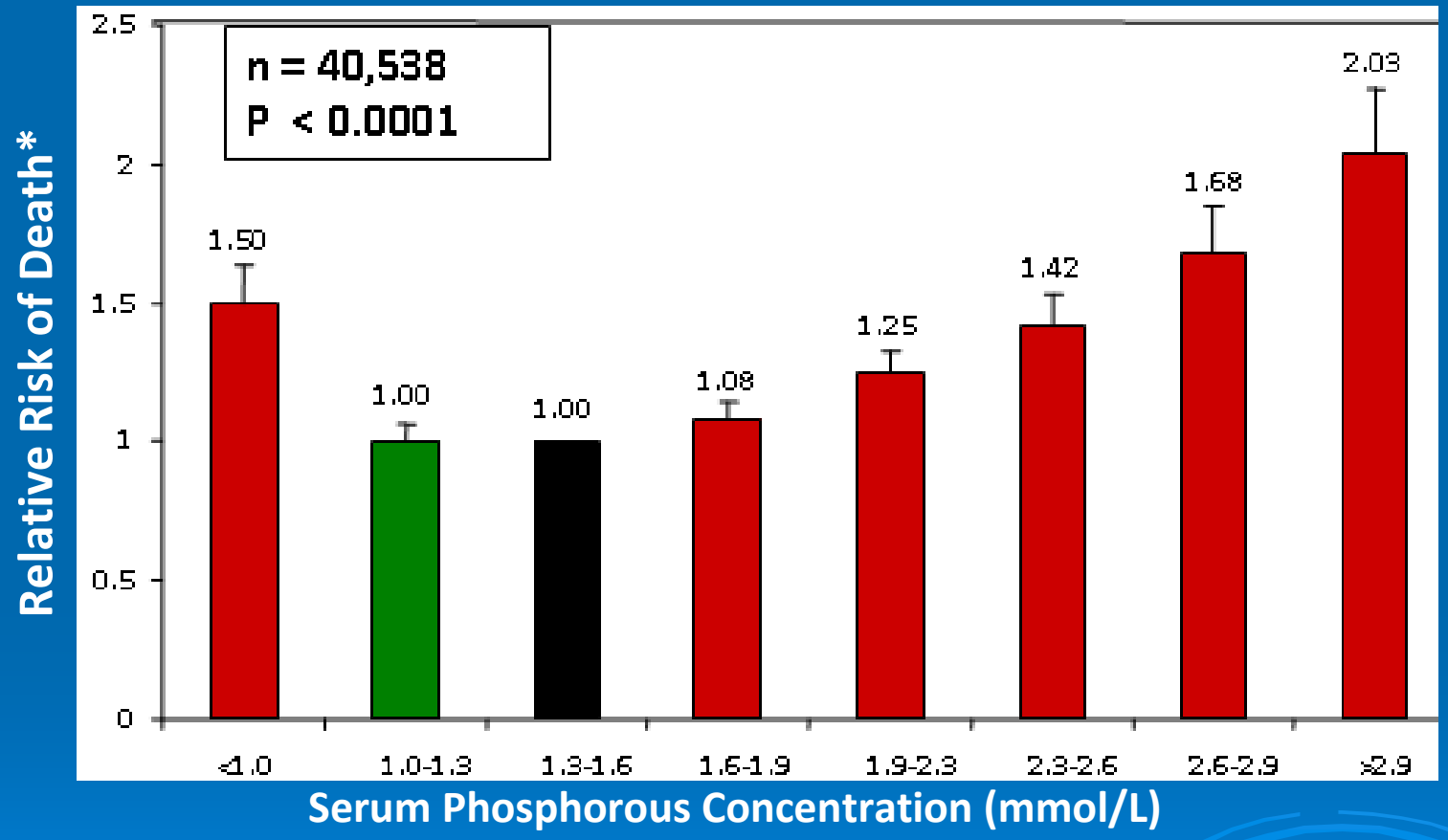


- Mortality increased linearly with an increase in serum phosphate

Adjusted hazard of mortality with each 0.32 mmol/L increase in serum phosphorus

Kestenbaum B. et al. J Am Soc Nephrol. 2005; 16(2):520-8.

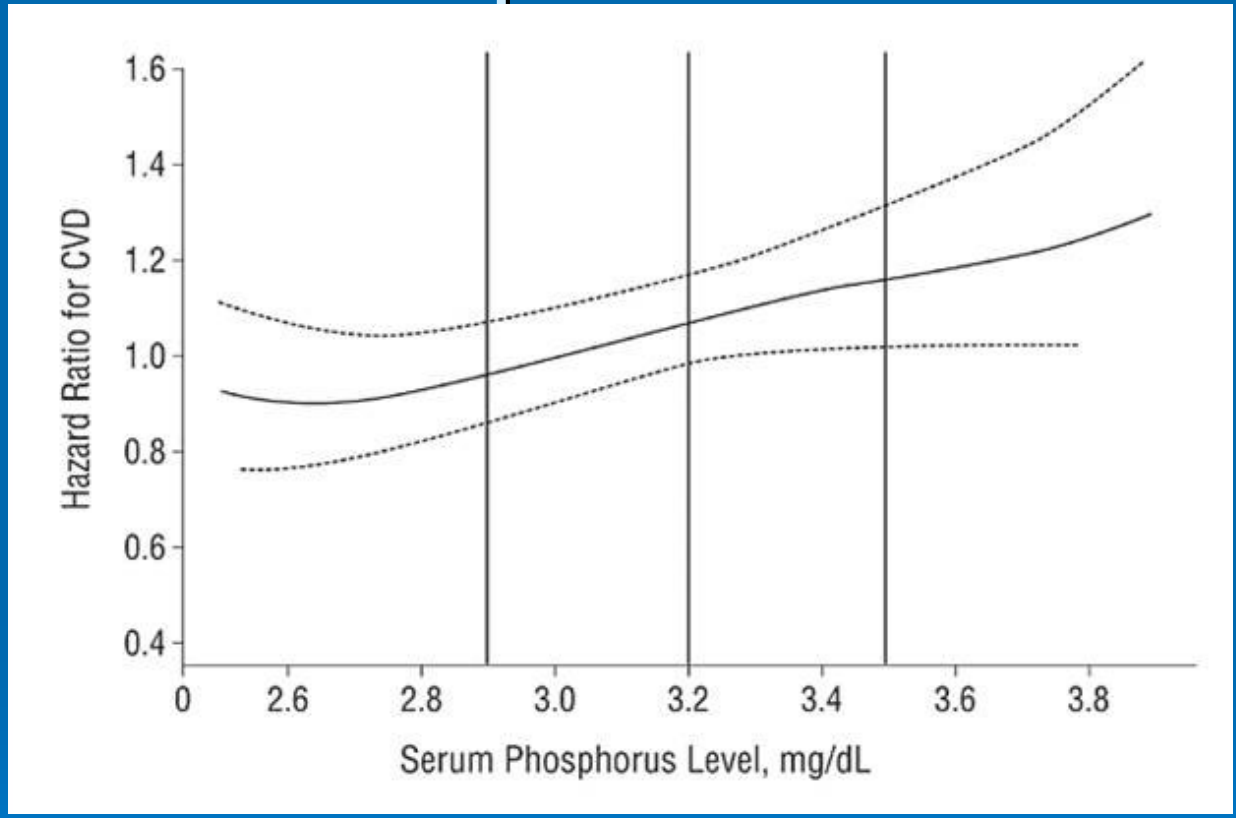
Phosphorus and Mortality in Dialysis



*Multivariable Adjusted

Block G, *J Am Soc Neph* 15: 2208-2218, 2004

Phosphorus in the Healthy Population



Serum phosphorus levels were shown to have a continuous association with increasing risk for morbidity and mortality within the reference range.

Dhingra R. Arch Intern Med. 2007; 167:879-85.

Phosphorus in Diabetes

Post Hoc Analysis of ABCD Cohort:

Serum phosphorus was associated with cardiovascular mortality in patients with Type 2 diabetes.

Chonchol et al. Am J Med. 2009 122(4):380-6

What is FGF-23?

- Protein secreted by osteocytes
- Maintains serum phosphorus in normal range in early CKD
  - Induces phosphaturia
  - Inhibits 1,25 $(OH)_2$ Vitamin D
- Induced by dietary phosphorus

FGF-23 and Progression of CKD

Early CKD

- Small cohort study (n=227)
- Non-diabetic patients
- FGF-23 independently predicted progression of CKD in mild kidney disease

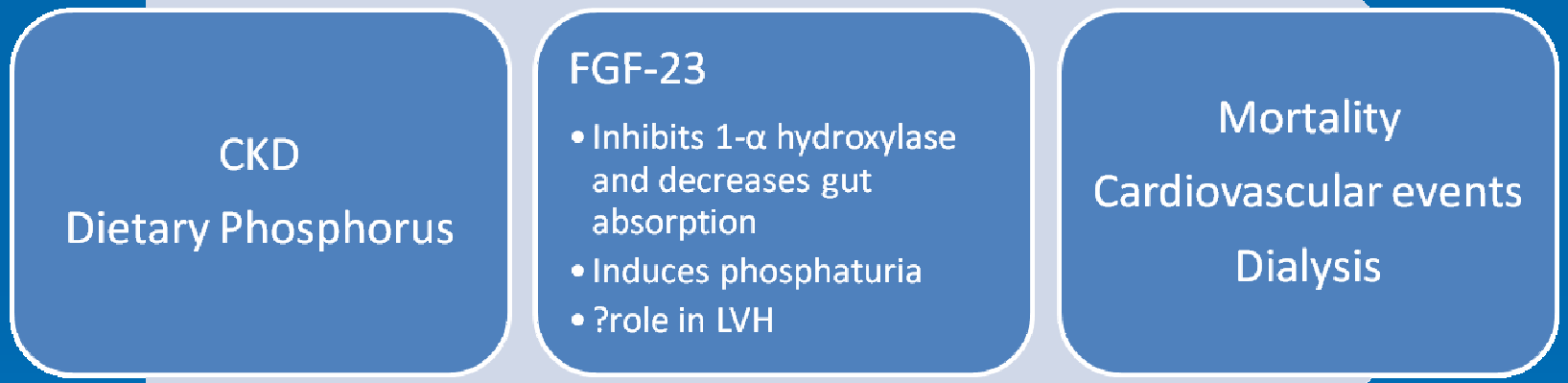
Fiser et al. J Am Soc Nephrol 2007 18: 2601-2608

Advanced CKD

- 1099 patients with advanced CKD
- Retrospective analysis
- Strong association with
  - All-cause mortality
  - Cardiovascular events
  - Dialysis initiation

Kendrick, J. et al. J Am Soc Nephrol 2011 22: 1913-1922

Phosphorus and Progression of CKD? Role of FGF-23?



Dietary Phosphorus

Source likely as important as amount

1. Organic phosphorus from meat/poultry/fish
2. Organic phosphorus from vegetarian sources
3. Phosphate additives
    - Extremely well absorbed in the gut
    - Found in cheap/convenience/fast foods
    - Information is not available on nutrition facts tables or in nutrient databases

Dietary Phosphate from Additives

- Estimates range from 10-30% of dietary phosphorus comes from additives
- Depending on food choices additives may increase dietary phosphorus by as much as 1000mg/d

Compare this to the CSN and KDOQI recommendations of 800-1000mg/d in CKD

Phosphorus

- Restrict dietary phosphorus from additives early in CKD
- Consider source and bioavailability
- Avoid processed foods
- As CKD progresses phosphate restriction from all sources (dairy, nuts, whole grains, seeds, legumes)
  - **Conflicts with most “healthy diet” advice**

Potassium

Not all patients require a restriction

- Stage 5 and hemodialysis
- Need to assess and correct for non-dietary causes of hyperkalemia
  - Insulin omission
  - Meds
  - Constipation (stage 5)
  - Acidosis

Potassium

- Restriction of 40-70mmol/d recommended
- Restricts whole grains, fruits, vegetables, dairy, nuts, seeds, legumes, lentils, salt substitutes

- **Becomes challenging to achieve adequate micronutrient and fibre intake**

Fluids

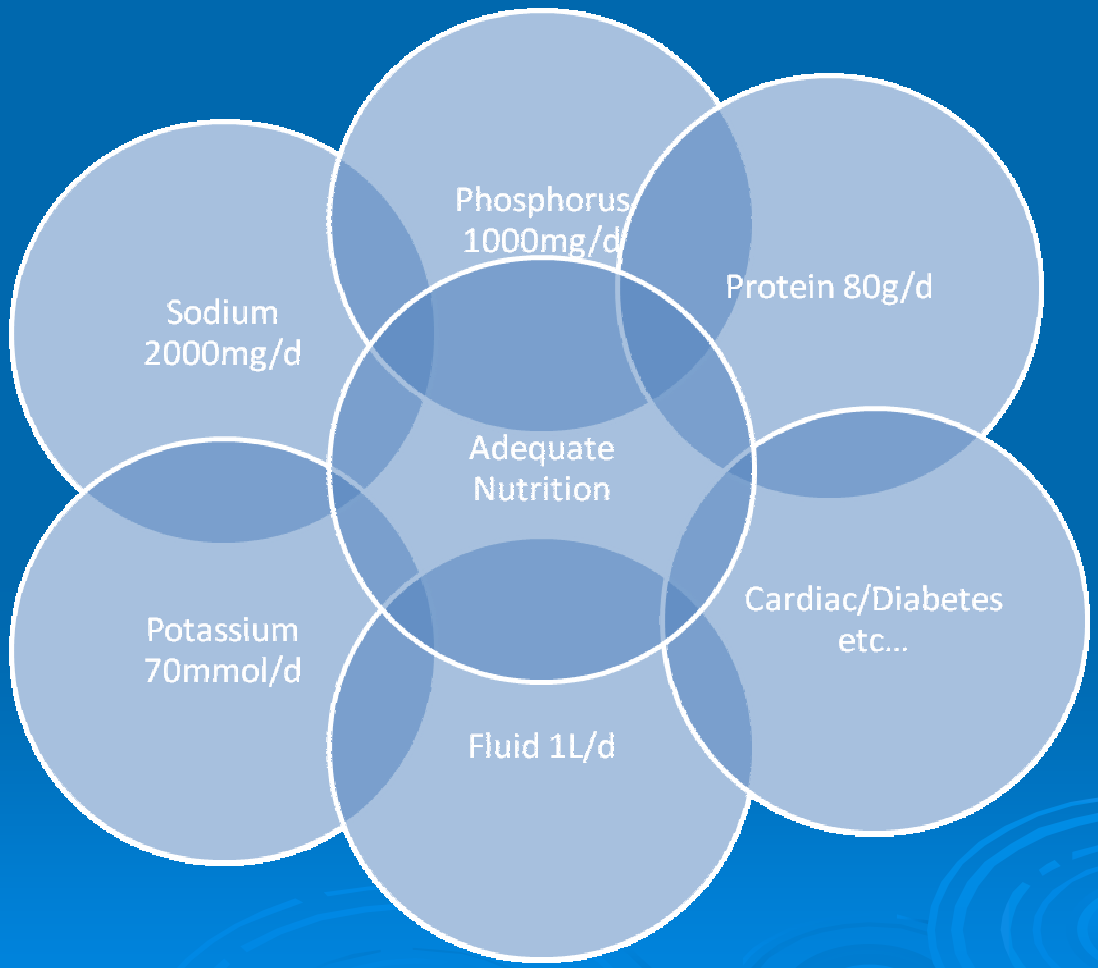
- Dialysis or CHF
- Fluid recommendations based on:
  - Residual renal function
  - CHF
  - Interdialytic weight gains
  - Body size

In conventional hemodialysis: 1L + urine output

Nutrition and CKD

- Across all stages of CKD, nutrition is associated with outcomes
- Need to provide patients with one, cohesive diet incorporating all diet recommendations
- Need to “design” and “redesign” diet as disease and treatments change

What is the renal diet?



What Can I Eat?

- Fresh, unprocessed meats
- Small servings of low potassium fruits and vegetables
- White breads, rice, pasta
- ½ cup dairy/day


www.myspiceitup.ca

Thank you!