

# **Dietary fiber for the management of chronic kidney disease**

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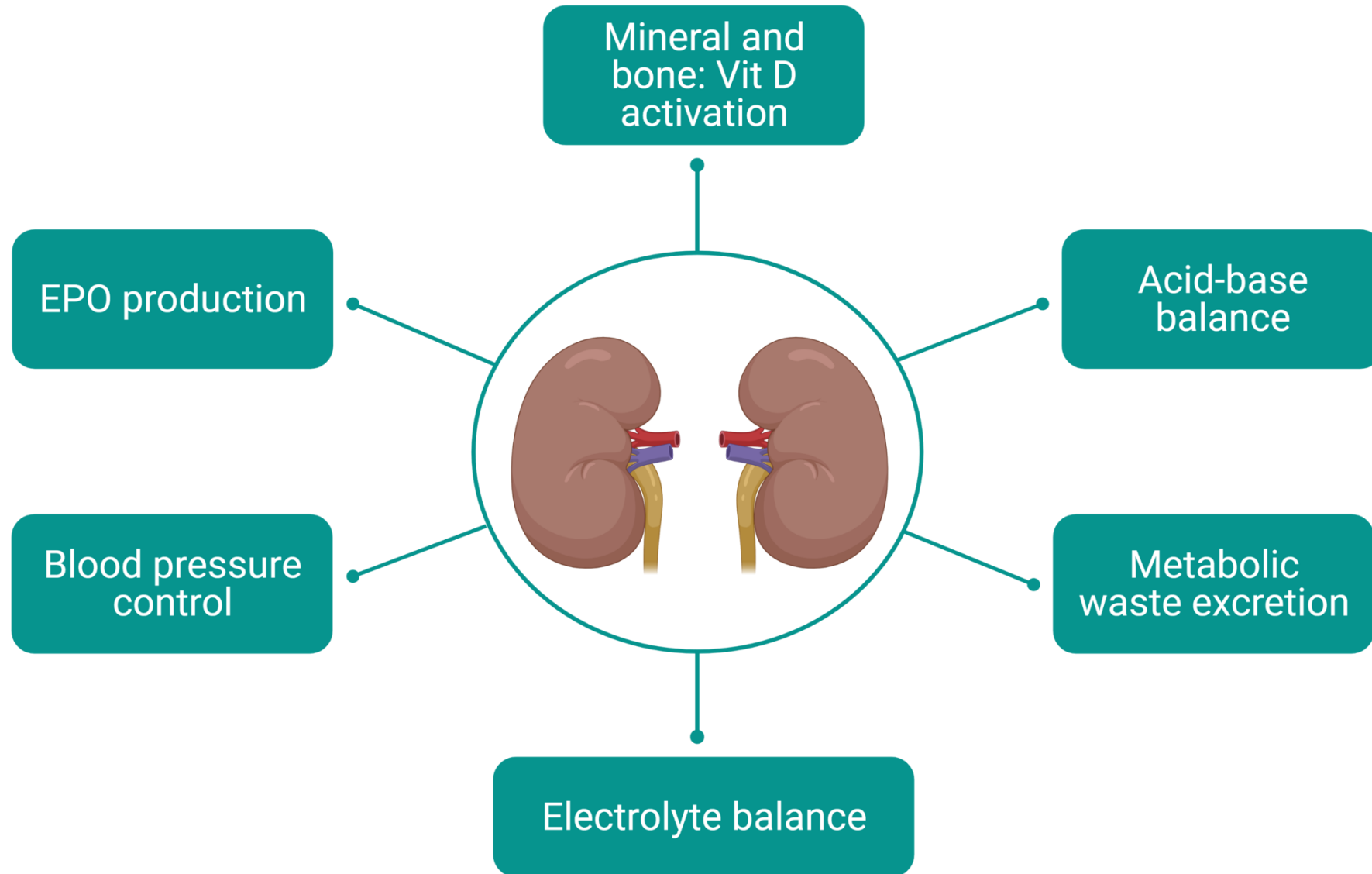
# Disclosures

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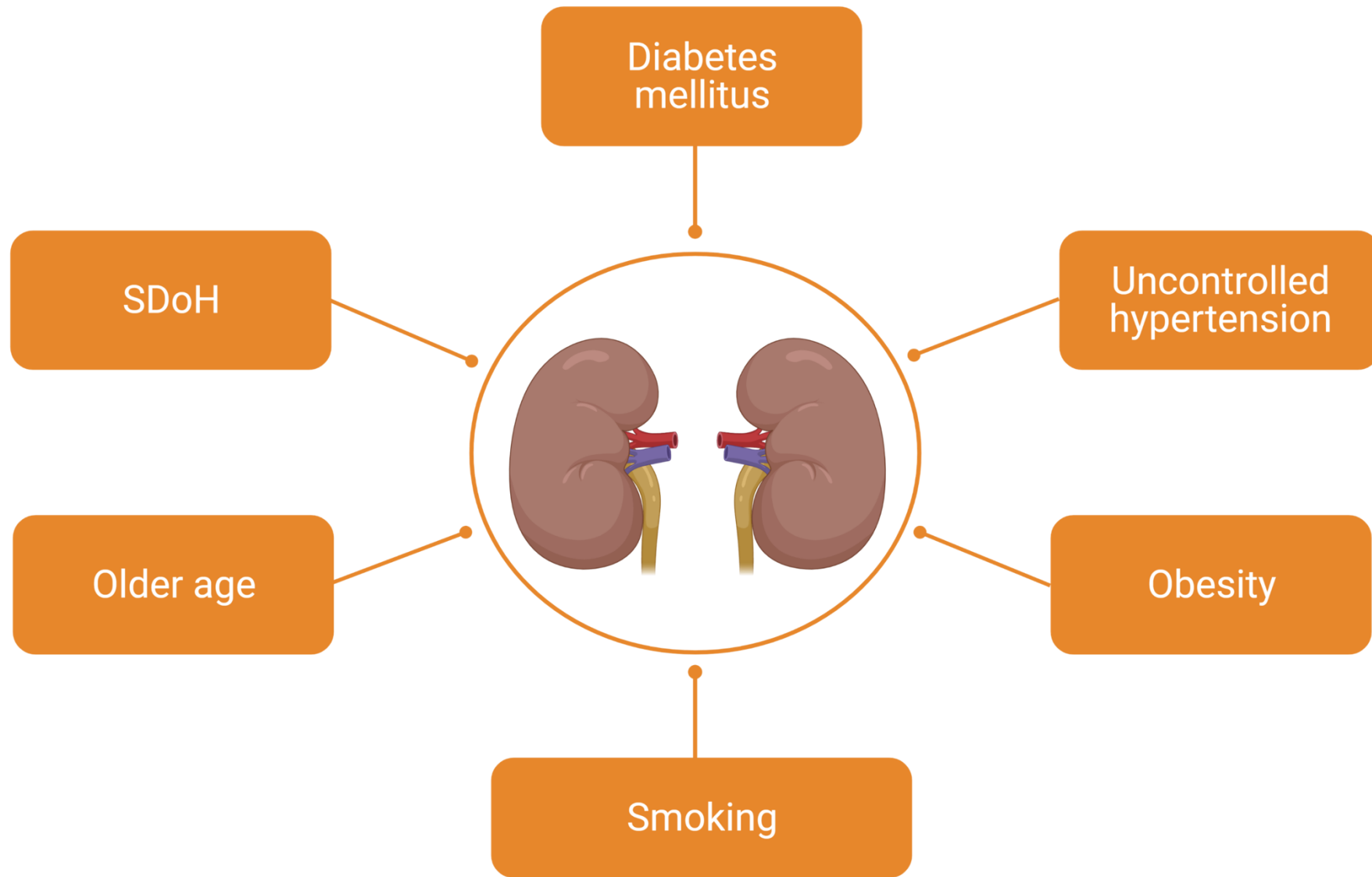
# Outline

1. Why are the kidneys important?
2. Is there a relationship between CKD (and its complications) and the gut microbiome?
3. How does dietary fiber impact a CKD-mineral and bone disorder?

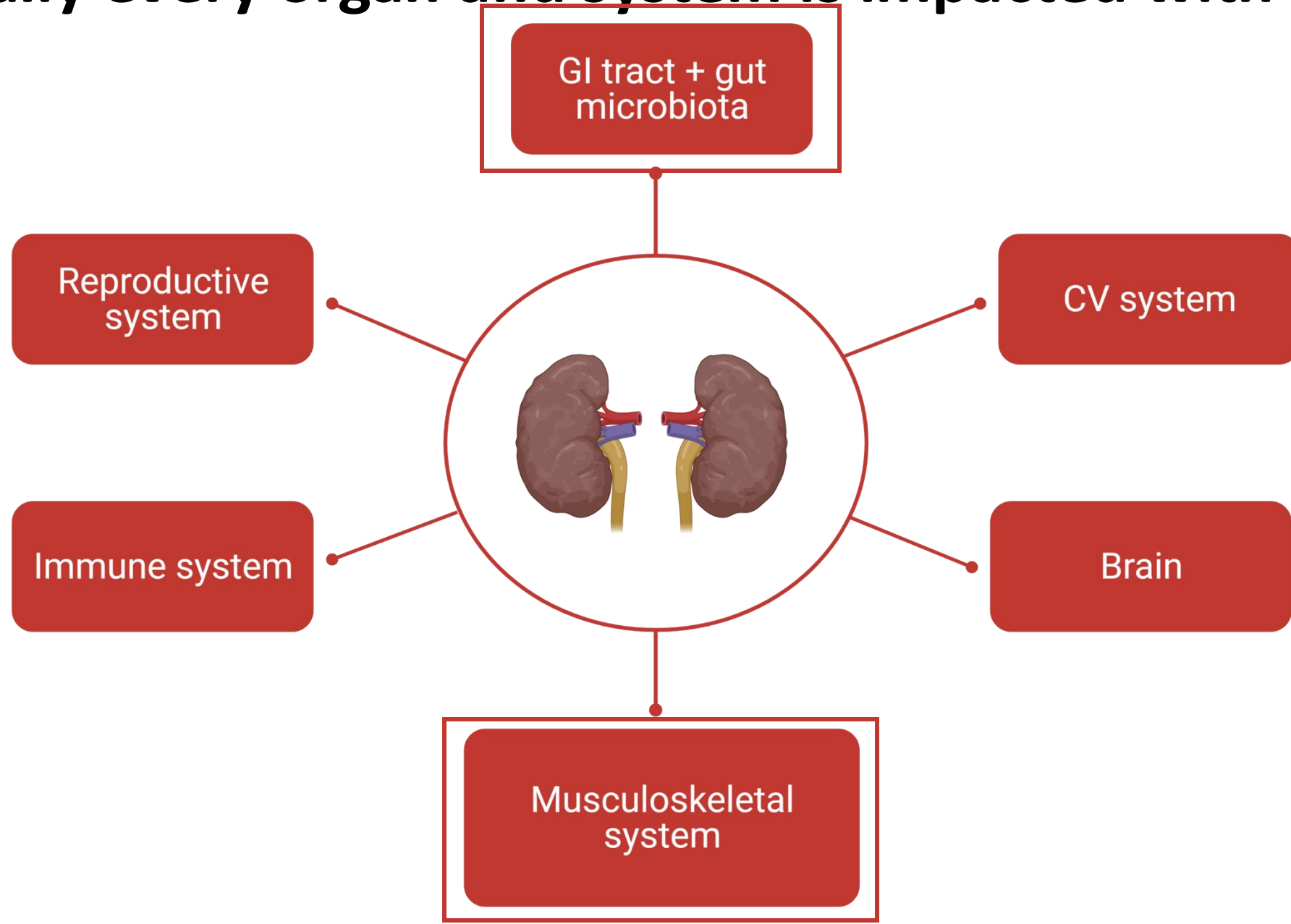
# The kidneys are the master regulators of homeostasis



# CKD is present in ~15% of the US population

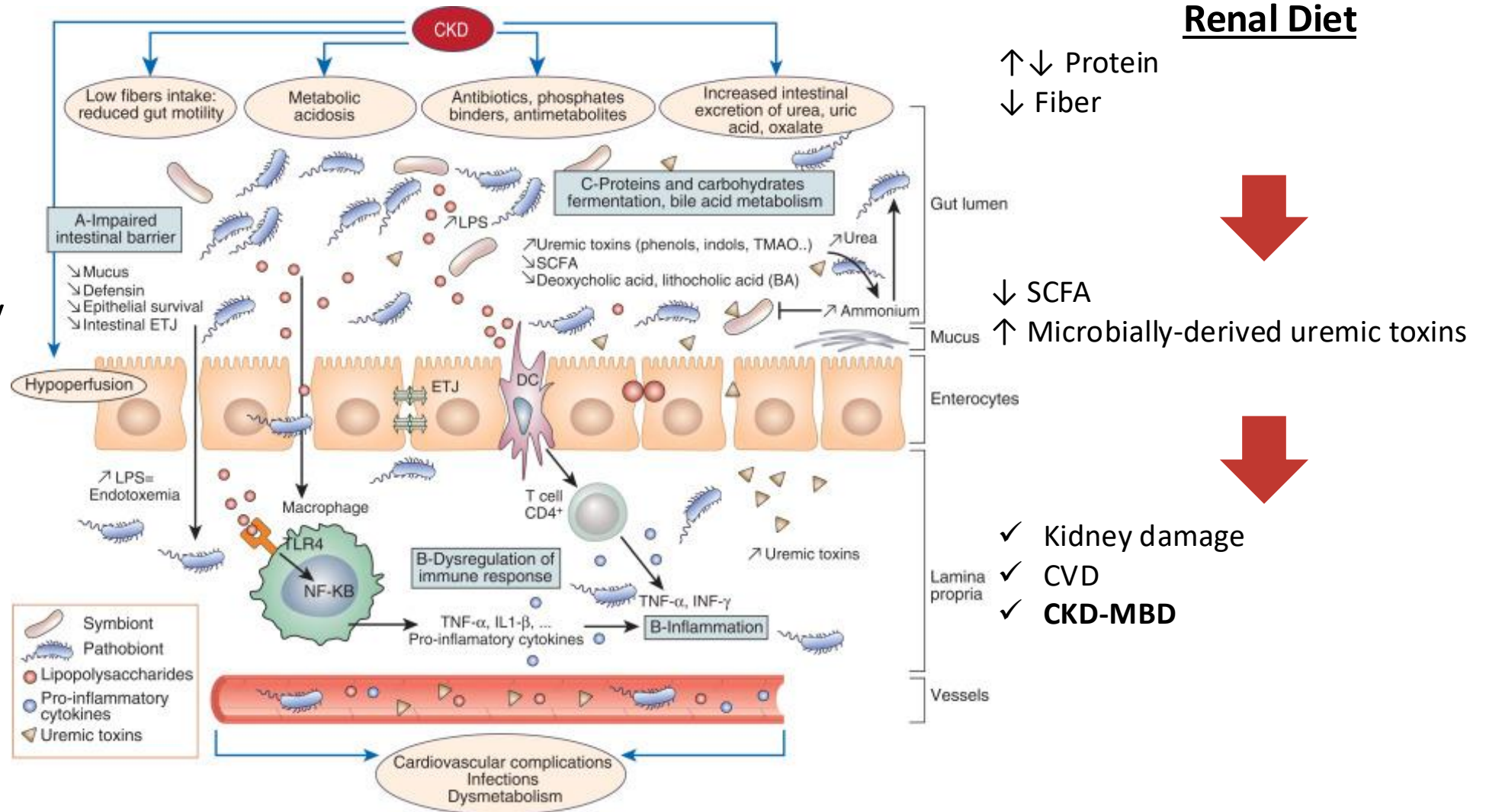


# Virtually every organ and system is impacted with CKD

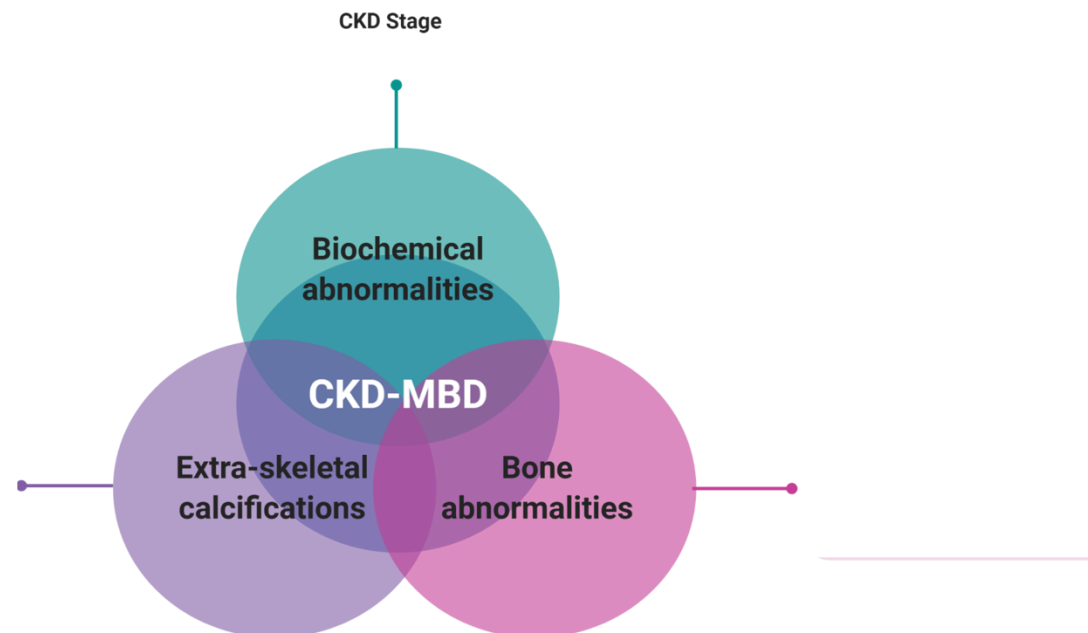


# The GI tract and the gut microbiome is affected in CKD

- ✗ Uremia
- ✗ Hyperpermeability
- ✗ ↑ GI symptoms
- ✗ Polypharmacy
- ✗ Intestinal edema



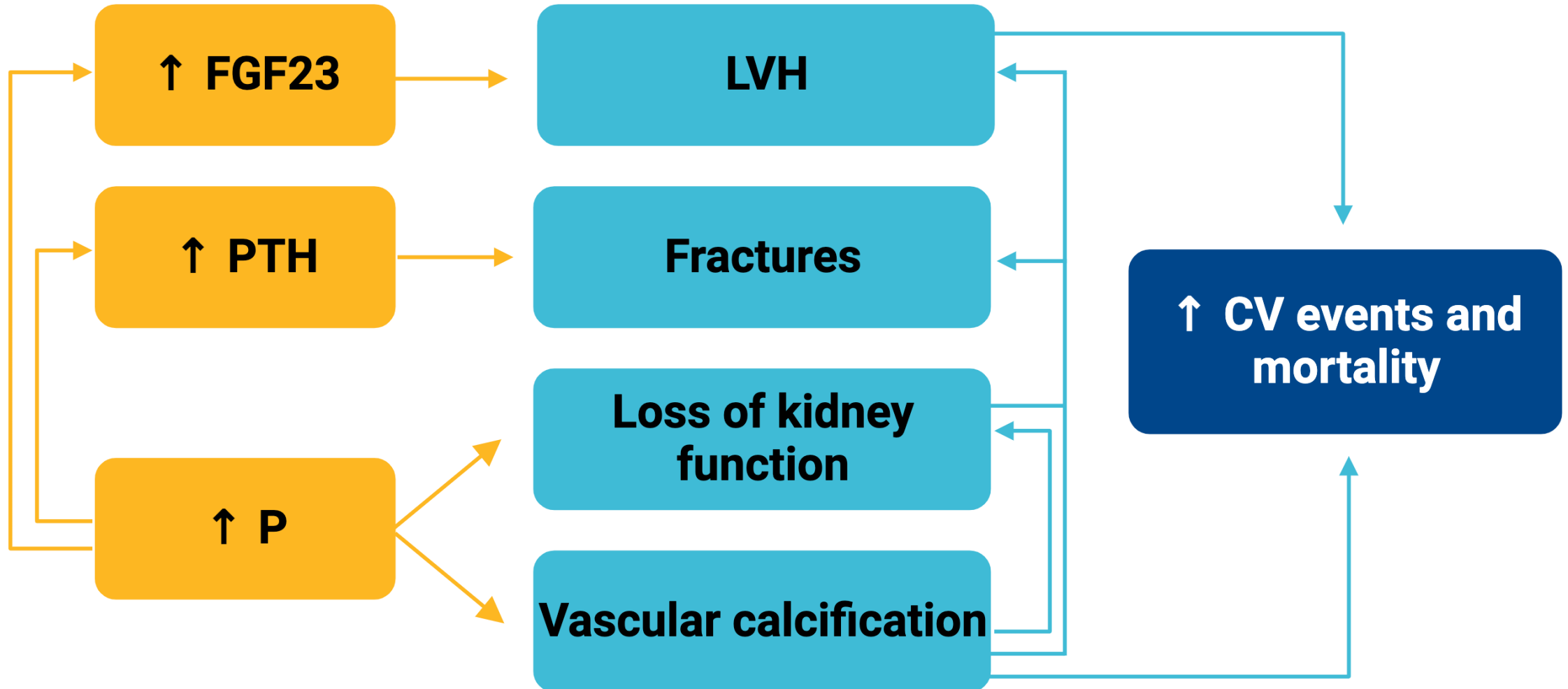
# CKD-MBD is highly prevalent in individuals with CKD



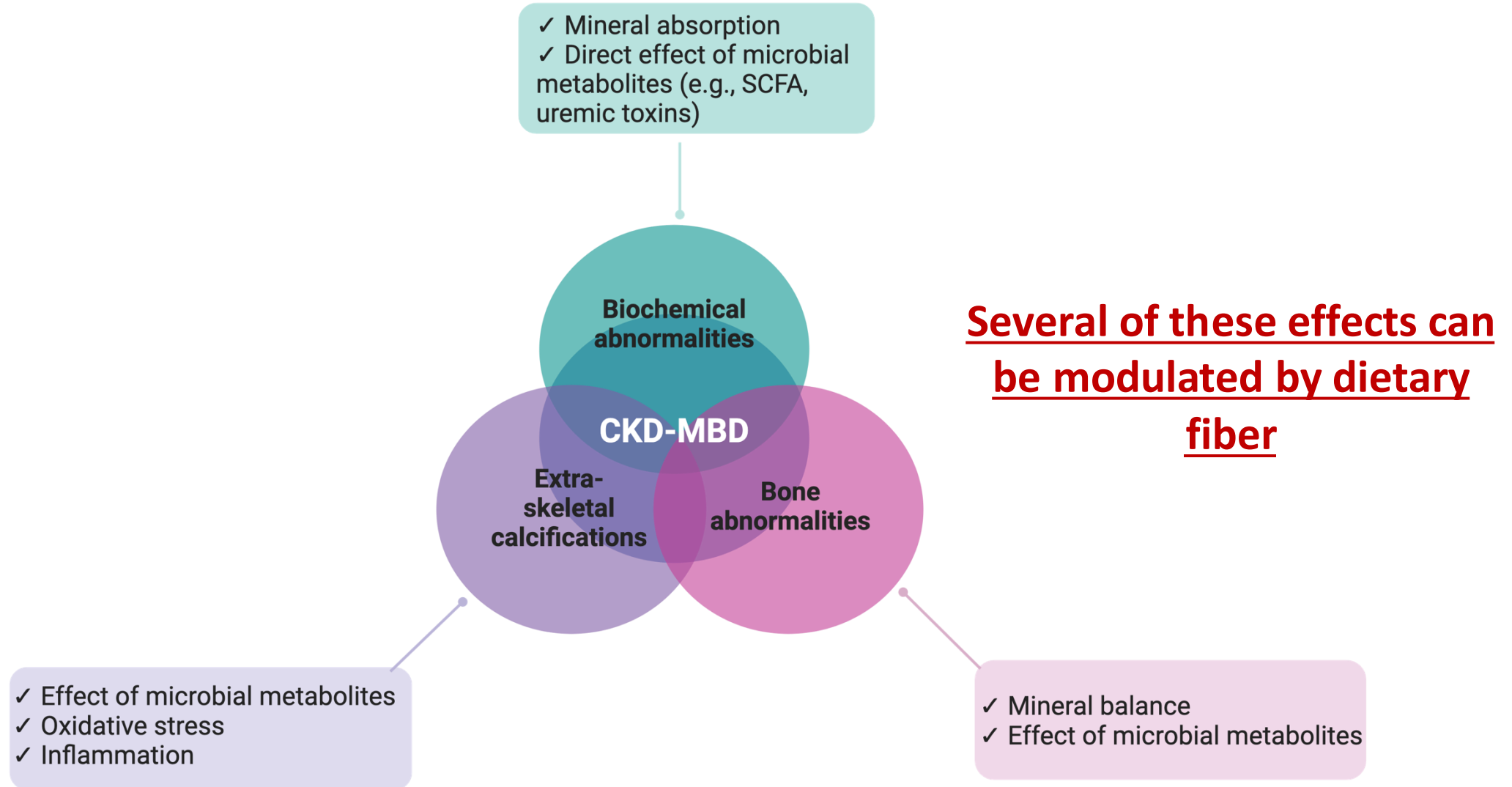
Adapted from Moorthi and Moe. Am J Kidney Dis (2011); Adapted from Wolf. JASN (2010)



# CKD-MBD leads to poor clinical and patient-centered outcomes



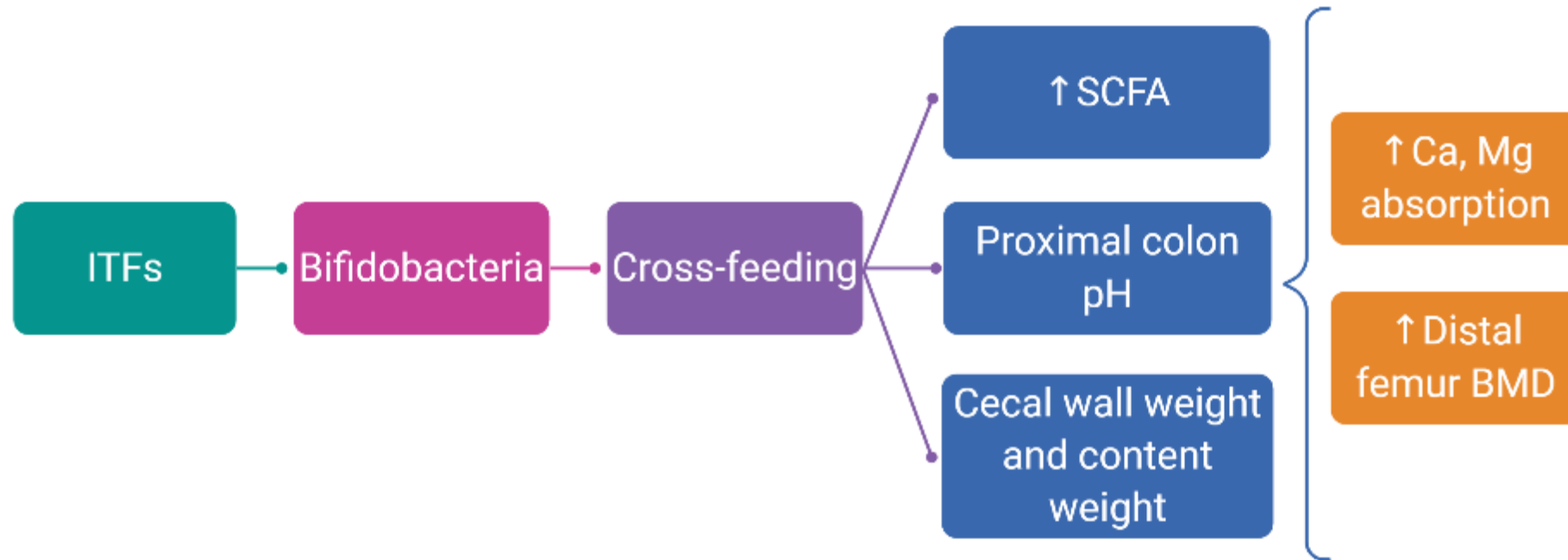
# The gut microbiome *may* affect CKD-MBD



# Dietary fiber: a potential key nutrient in CKD-MBD

- Non-digestible CHO polymers + lignin
- Dietary fiber intake in CKD is ~50% of the AI
- Dietary fiber intake is inversely related to CKD incidence and progression
- The properties of dietary fiber may be key for the outcomes of choice
  - ↑SCFA ↓ GDUT
  - Mineral absorption and homeostasis
  - ↓ Inflammation and oxidative stress

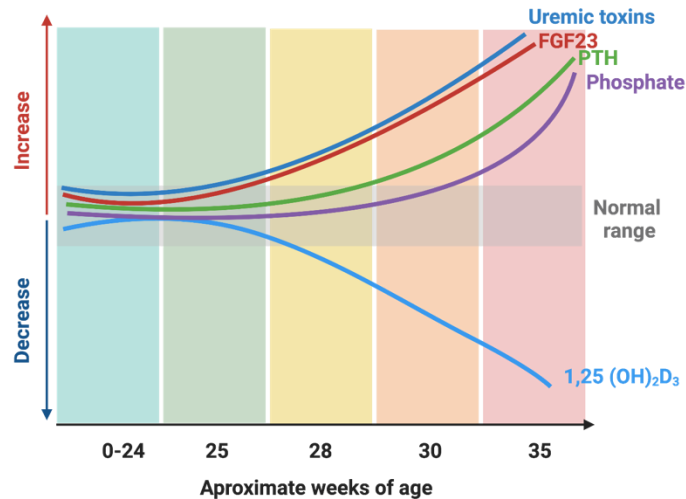
# Fermentable dietary fibers can impact mineral and bone-related outcomes



# The Cy/+ male rat model is a progressive model of CKD-MBD that responds to diet/medications

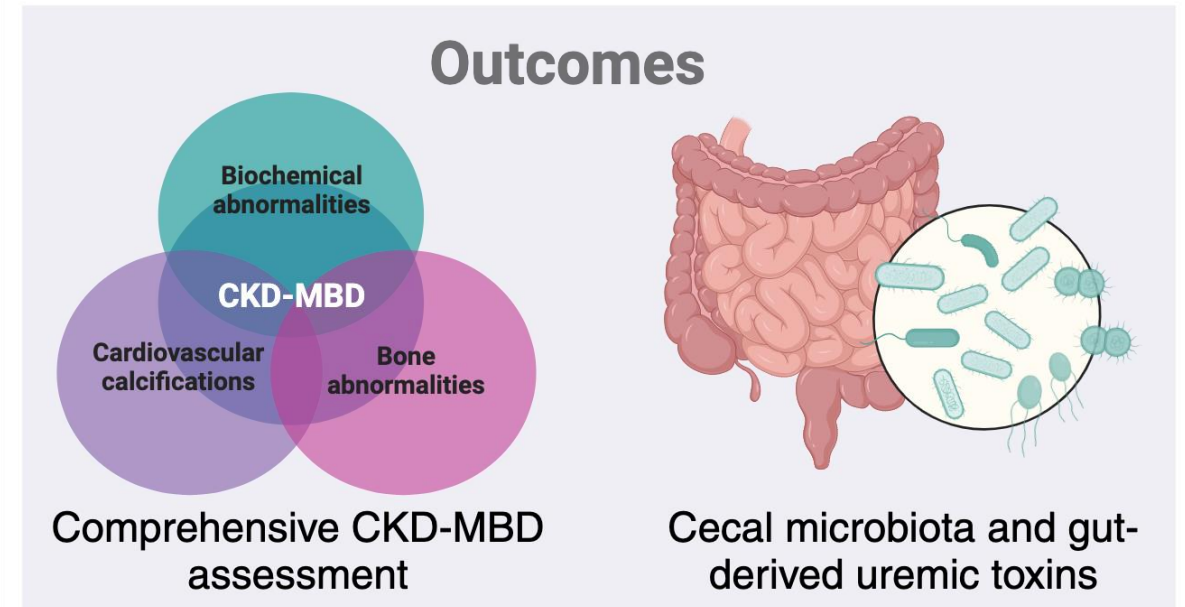
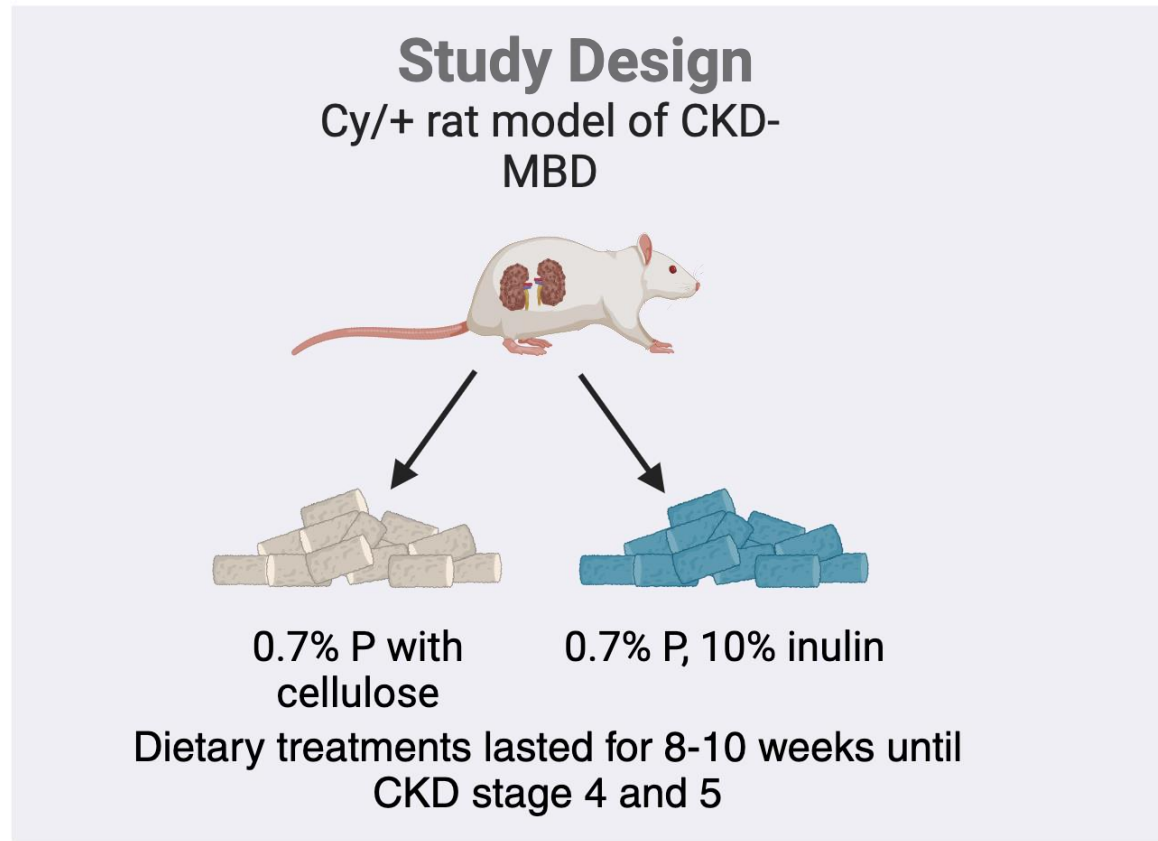


Cy/+ male rat model of CKD-MBD fed a 0.6% P casein-based diet



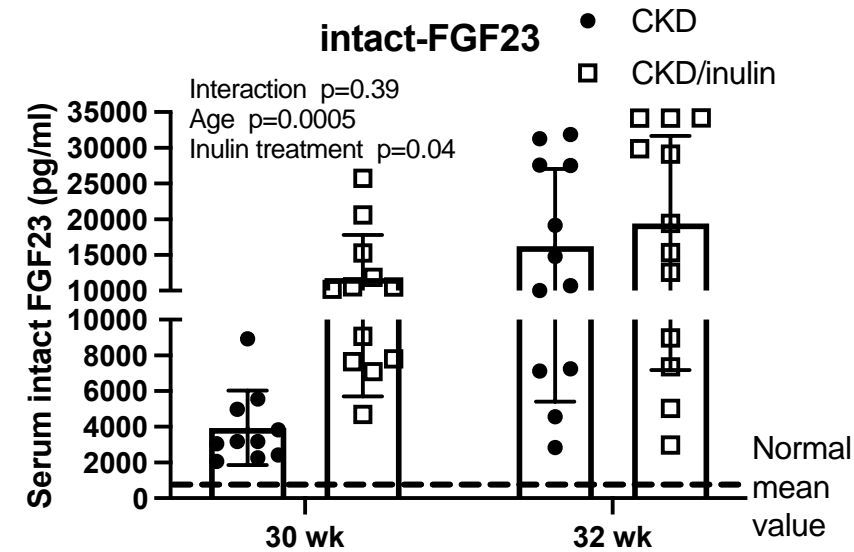
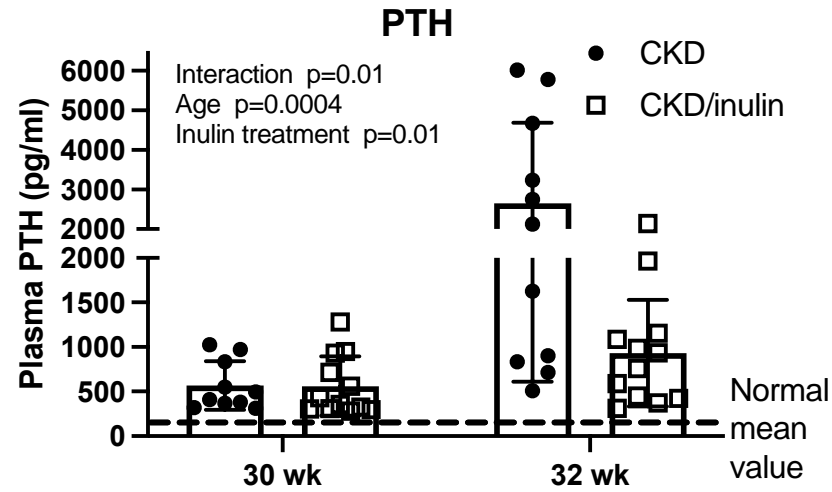
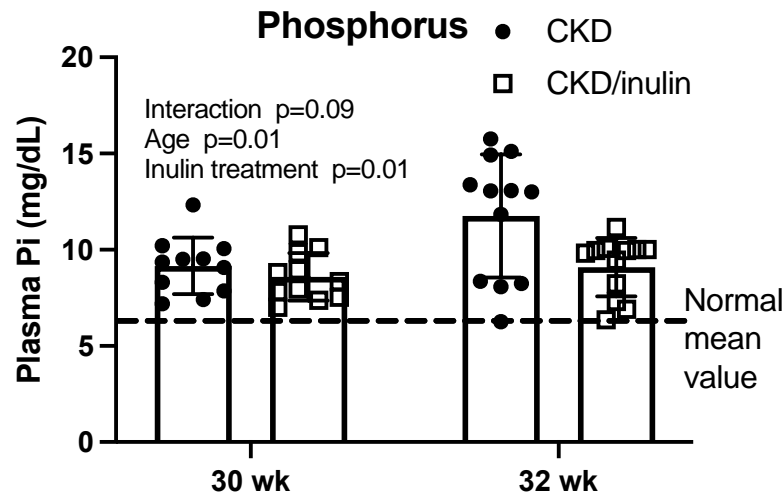
- ✓ Slowly, progressive
- ✓ Therapies can be tested at various stages
- ✓ Responds to medications and lifestyle interventions
- ✗ Only males
- ✗ ~33 weeks of age for kidney failure
- ✗ Some may progress fast

# In a controlled environment, what is the effect of inulin supplementation?

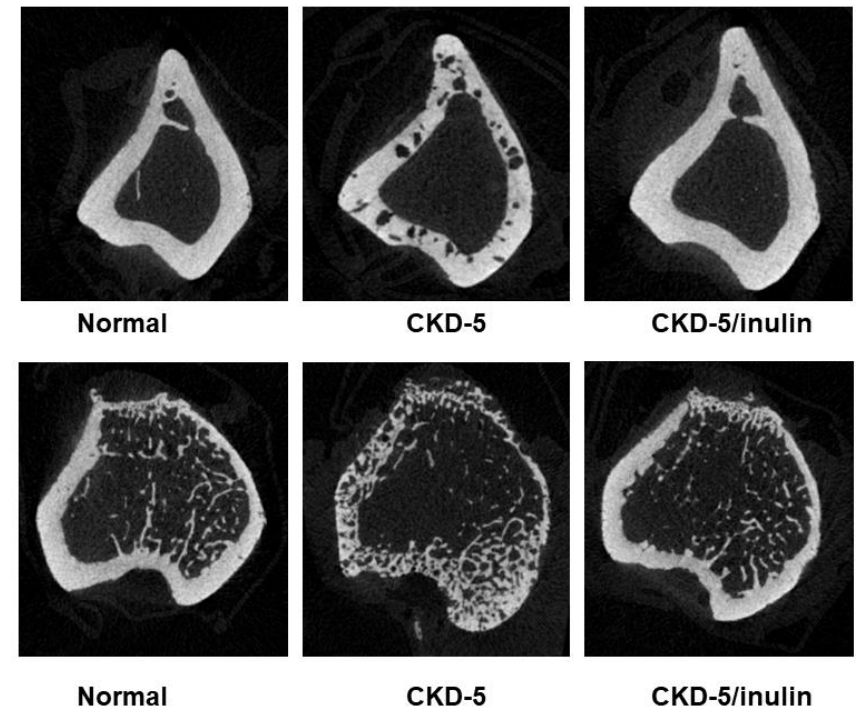
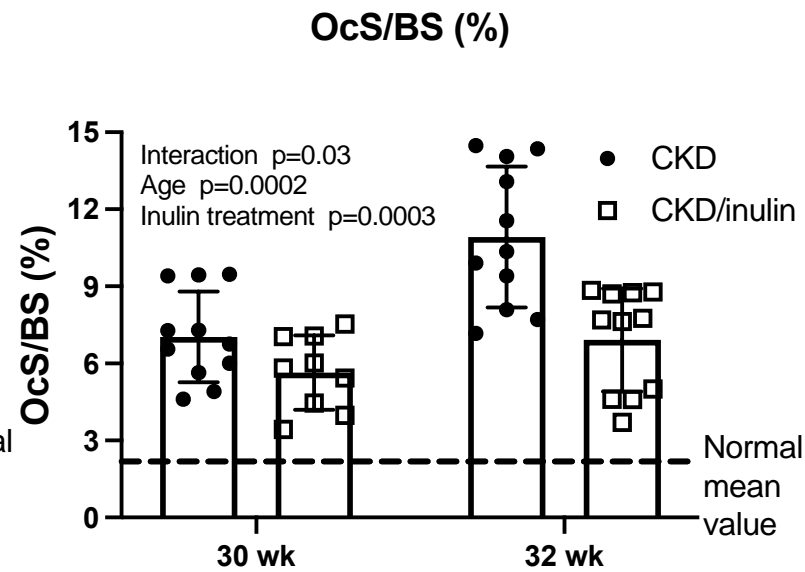
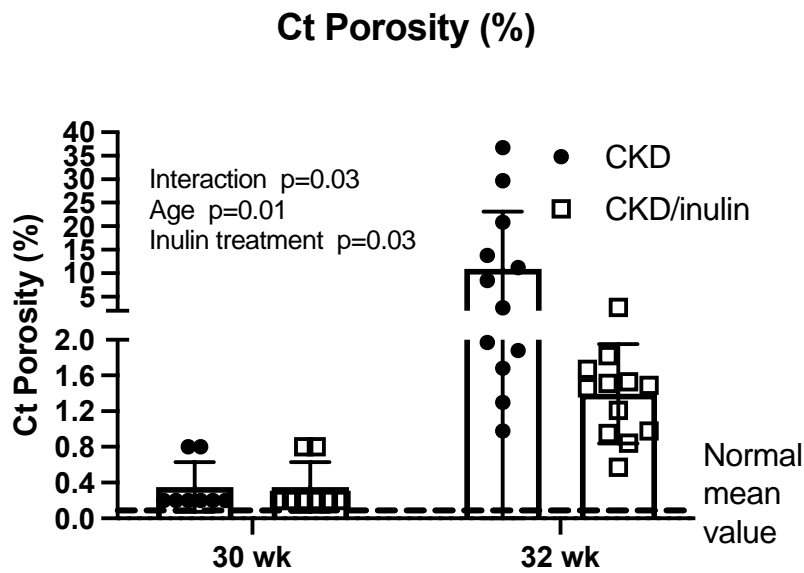


# Inulin lowered plasma phosphorus and PTH in rats with CKD

- Kidney function was not different

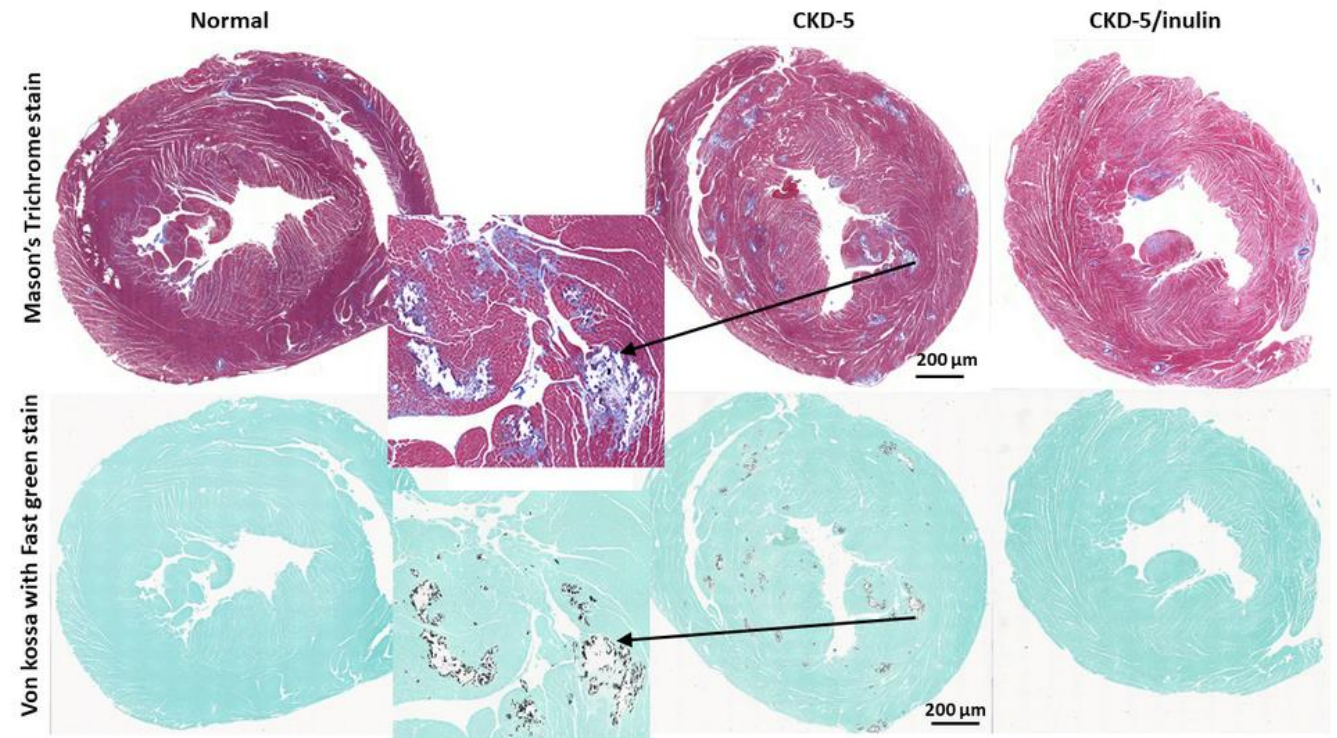
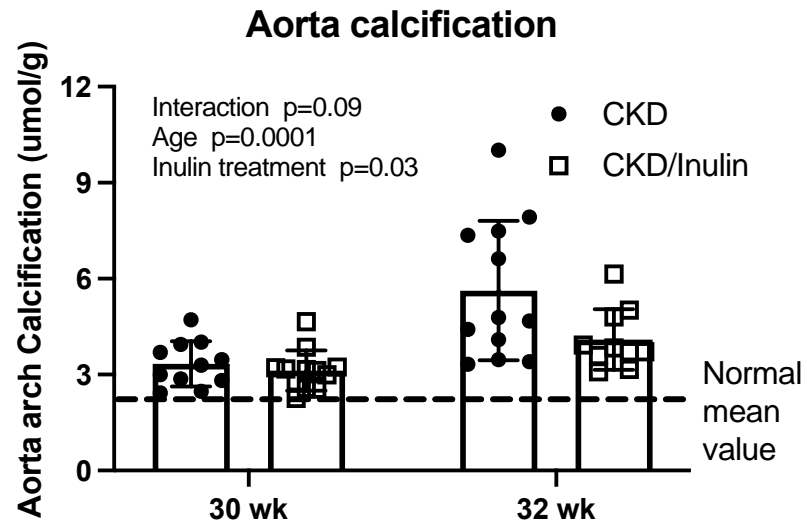


# Inulin improved cortical bone but did not improve bone mechanics

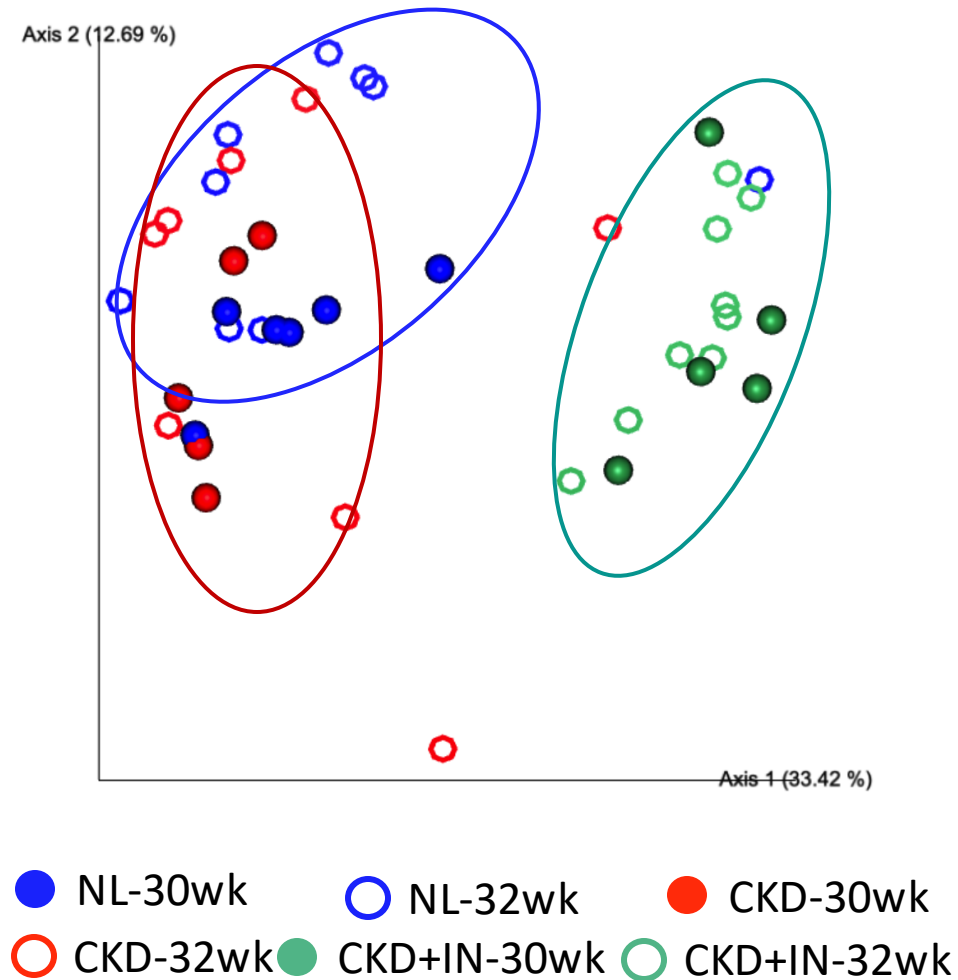
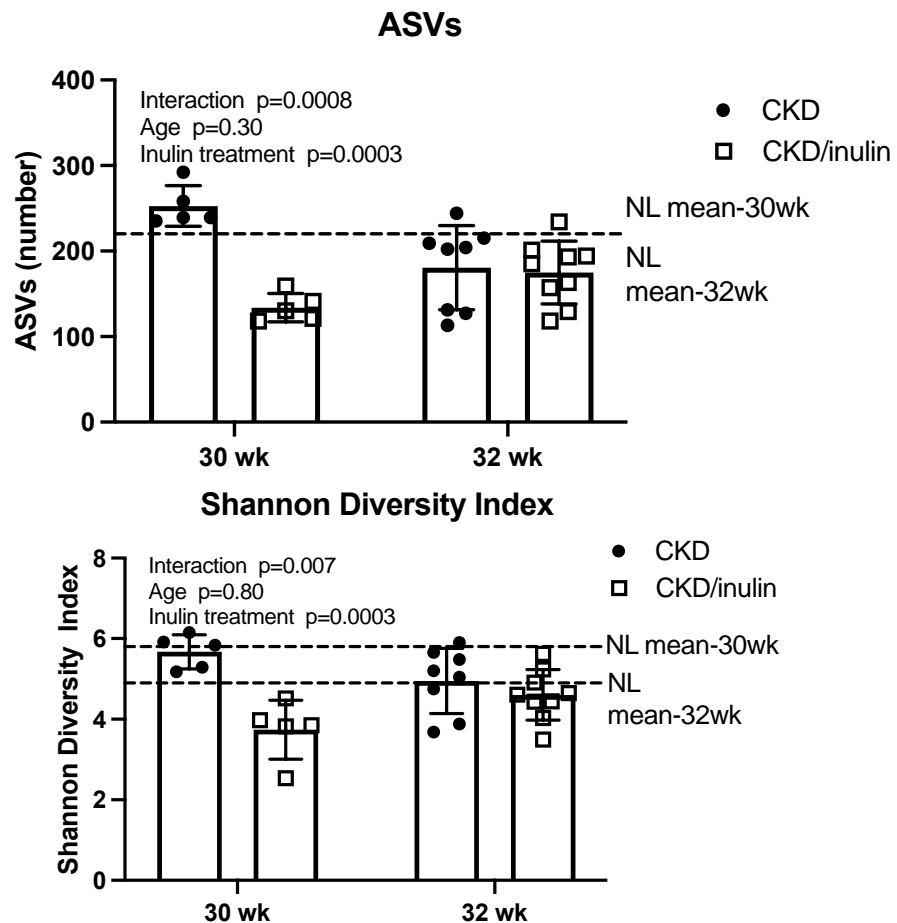




# Inulin supplementation lowered aorta and heart calcifications and fibrosis

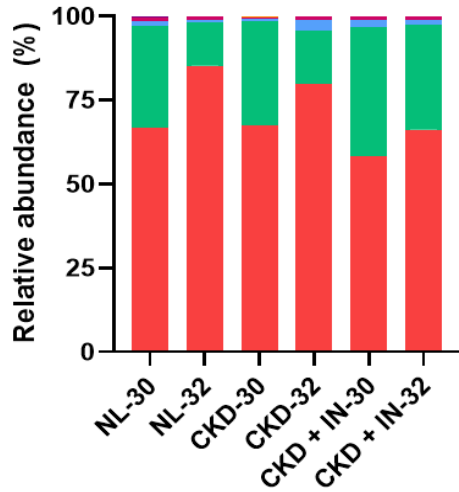


# Inulin supplementation impacted $\alpha$ - and $\beta$ -diversity

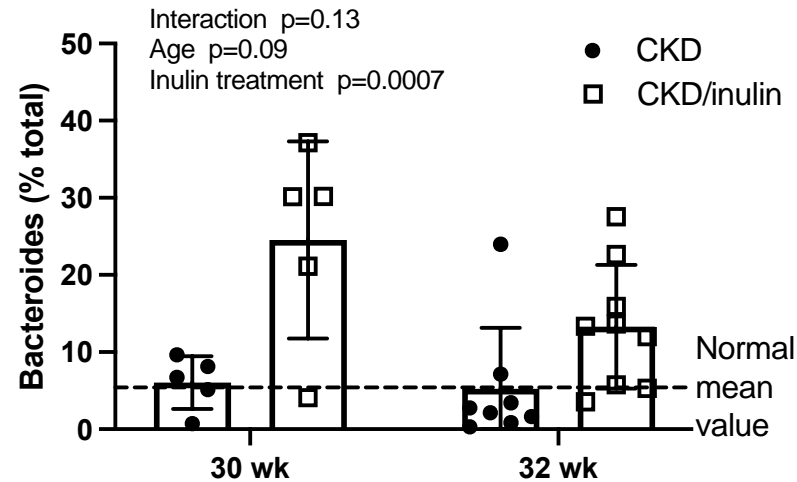


*Similar effect for PD*

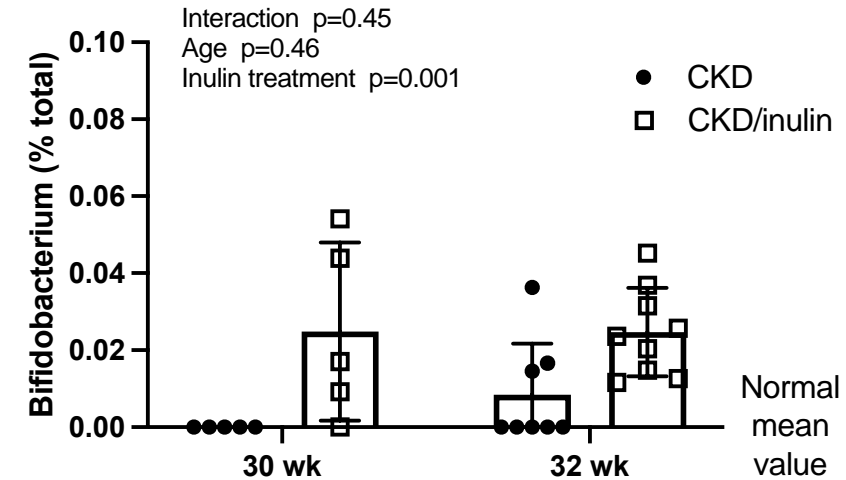
# Inulin altered the gut microbiota and lowered gut-derived uremic toxins



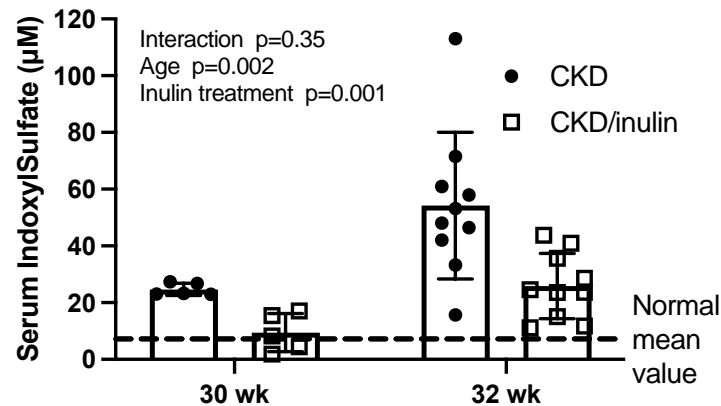
**A: Bacteroides**



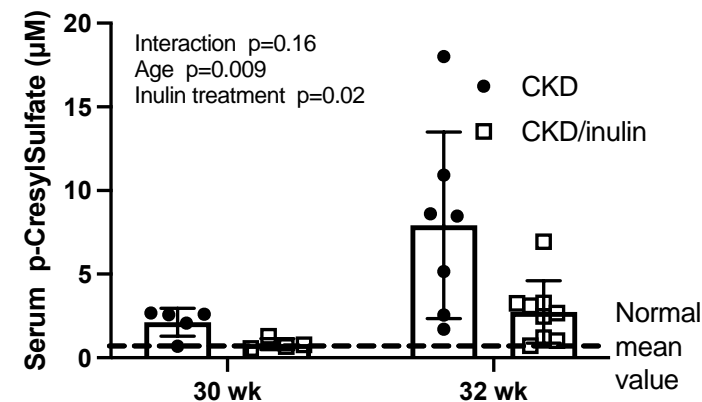
**D: Bifidobacterium**



**IndoxylSulfate**



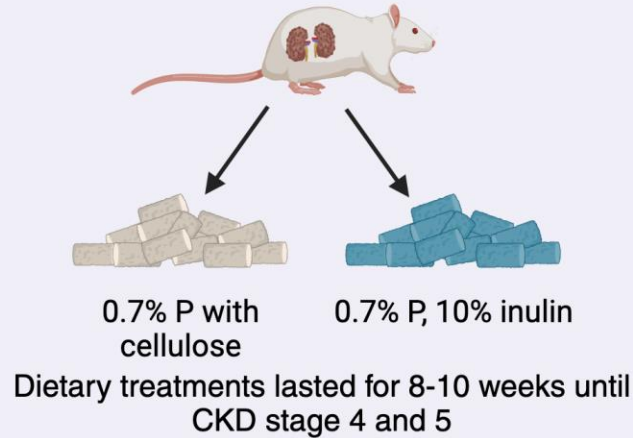
**p-CresylSulfate**



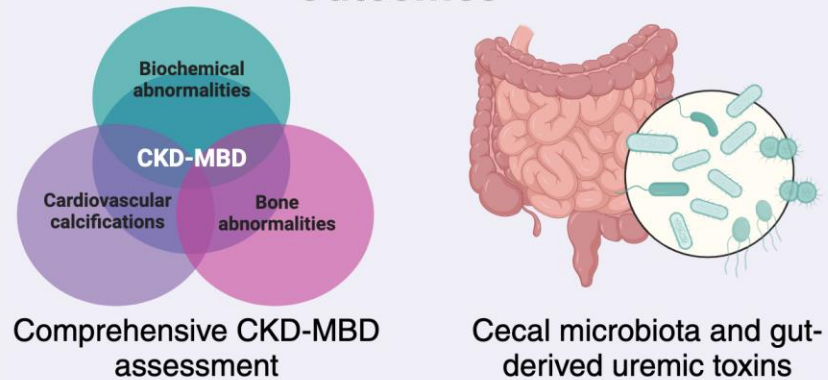
# The fermentable fiber inulin improves chronic kidney disease-mineral and bone disorder in a rat model of chronic kidney disease

## Study Design

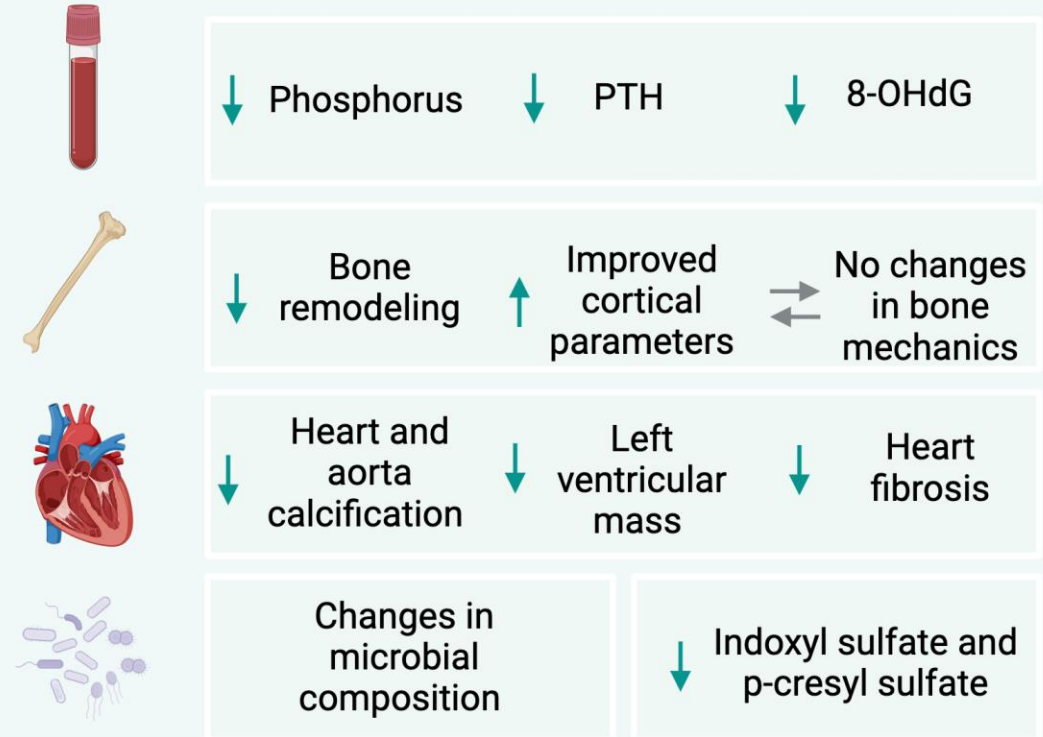
Cy/+ rat model of CKD-MBD



## Outcomes



## Results



**Conclusions:** The supplementation of the fermentable fiber inulin, improved CKD-MBD parameters. The mechanisms may be mediated by the beneficial impact on the gut microbiota and the lower gut-derived uremic toxins, but more studies are needed.

# Conclusions

- CKD-MBD is a highly prevalent complication in CKD.
- Gut-oriented therapies may be innovative and low-cost interventions to improve CKD-MBD-related outcomes.
- Clinical trials are needed
  - We started supplementation in early-to-moderate CKD
  - Is there a benefit for people with kidney failure?
  - What is the therapeutic dose?

# ¡Gracias!

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