Great Ormond Street Hospital for Children
NHS Foundation Trust

The Association of UK Dietitians

PHOSPHATE MANAGEMENT in PAEDIATRIC CHRONIC KIDNEY DISEASE:

Principles and practice

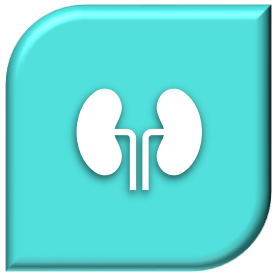
Louise McAlister

Highly Specialised paediatric kidney dietitian

GOSH, London, UK

Plan

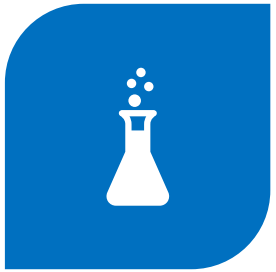
WHAT IS PHOSPHATE?

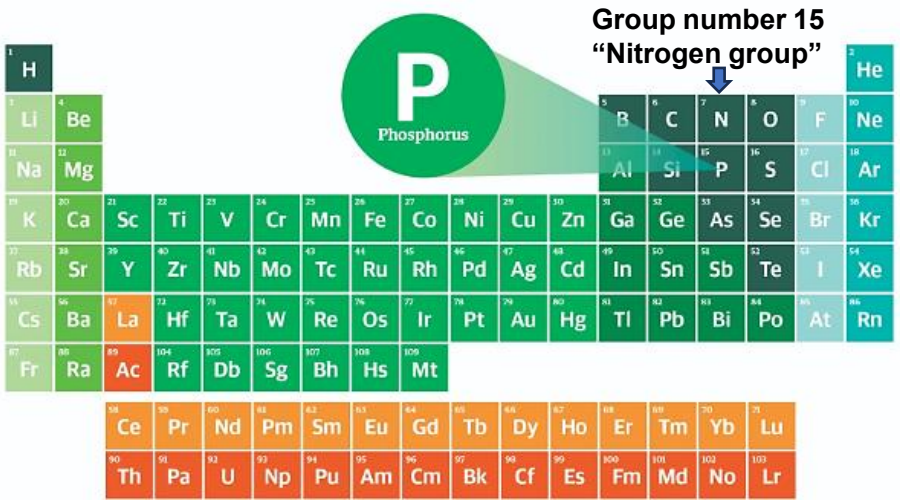


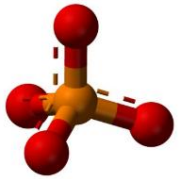
WHAT HAPPENS IN CHRONIC KIDNEY DISEASE?

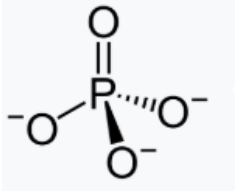
DIETETIC ADVICE FOR PAEDIATRIC CKD?

WHAT ARE THE CHALLENGES?







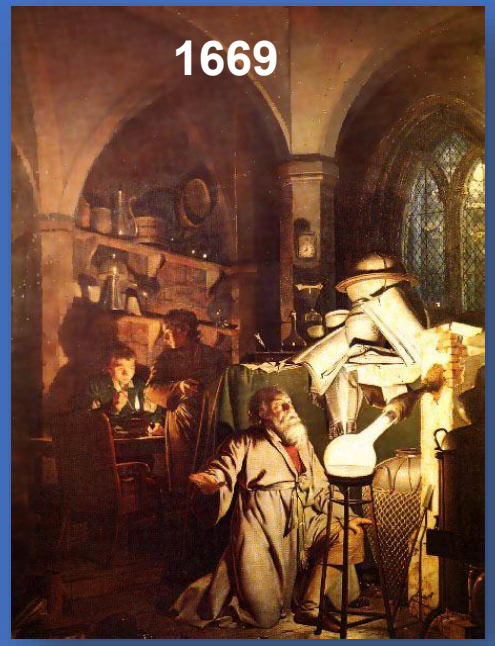


Biologically active form – PO_4^{3-}

Phosphorus **never occurs free in nature** — it’s always bound to something.

Allotropes:

White phosphorus	highly reactive, toxic, glows faintly in air
Red phosphorus	more stable
Black phosphorus	more inert



The Alchemist Discovering Phosphorus
Joseph Wright of Derby 1771

1769
Bone meal

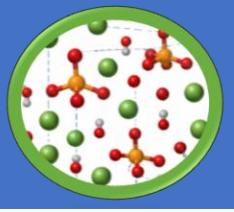
Body Phosphate distribution

500-700g P

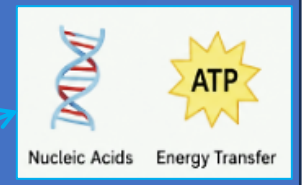
(22,000 mmol PO_4^{3-})

1% body weight

- **Bones and teeth (~85%)**
- **Soft tissues & cells (~14%)**
- **Blood (<1%)**



$Ca_{10}(PO_4)_6(OH)_2$



- UK laboratory systems measure **inorganic phosphate** ions
- USA may say ***phosphorus***

Paediatric – blood phosphate reference ranges

Age group	Reference range (mmol/L)*
<5 days	1.5 - 2.6
5 days-3 yrs	1.2 - 2.1
Child 3-10 yrs	1.2 - 1.8
Adolescent 10-15 yrs	1.1 - 1.75
Adults	0.8 - 1.45

*SI units

GOSH; Lockitch 1988

P (mg/dL) **= phosphate** (mmol/L) **x 3.1**

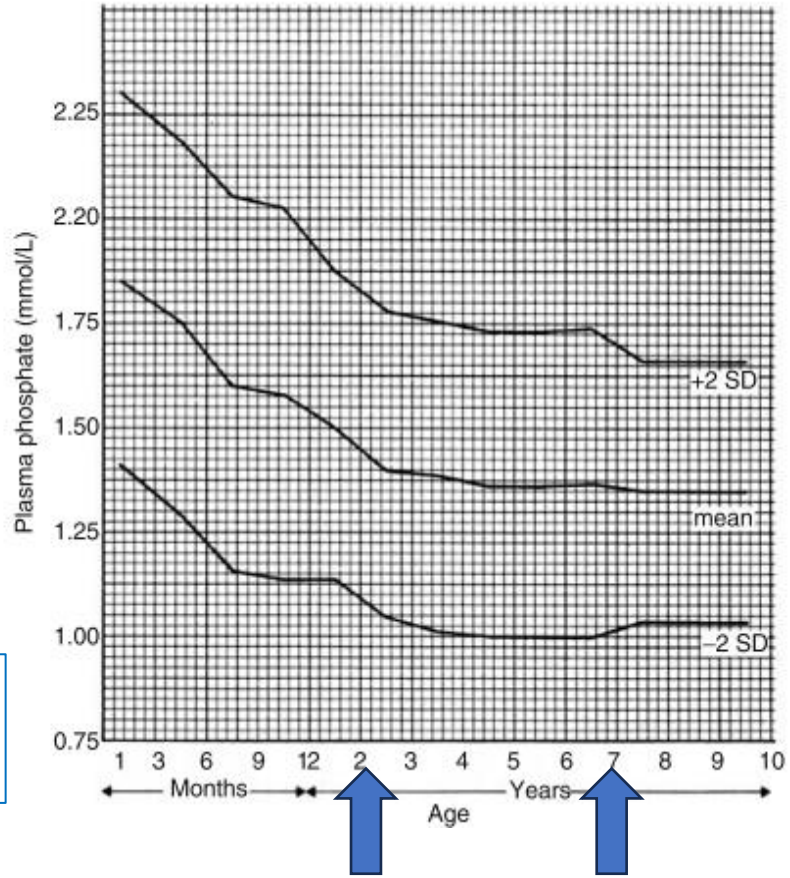
UK hospital published 2022

NHS Foundation Trust

Age group	Reference range (mmol/L)
Neonate	1.0 - **2.7**
Infant	1.3 - **2.4**
Child	0.8 - 1.9
Adults	0.8 - 1.5

CALIPER

SickKids (Toronto)
~15,000 healthy children
Community based/multiethnic
Different analysers



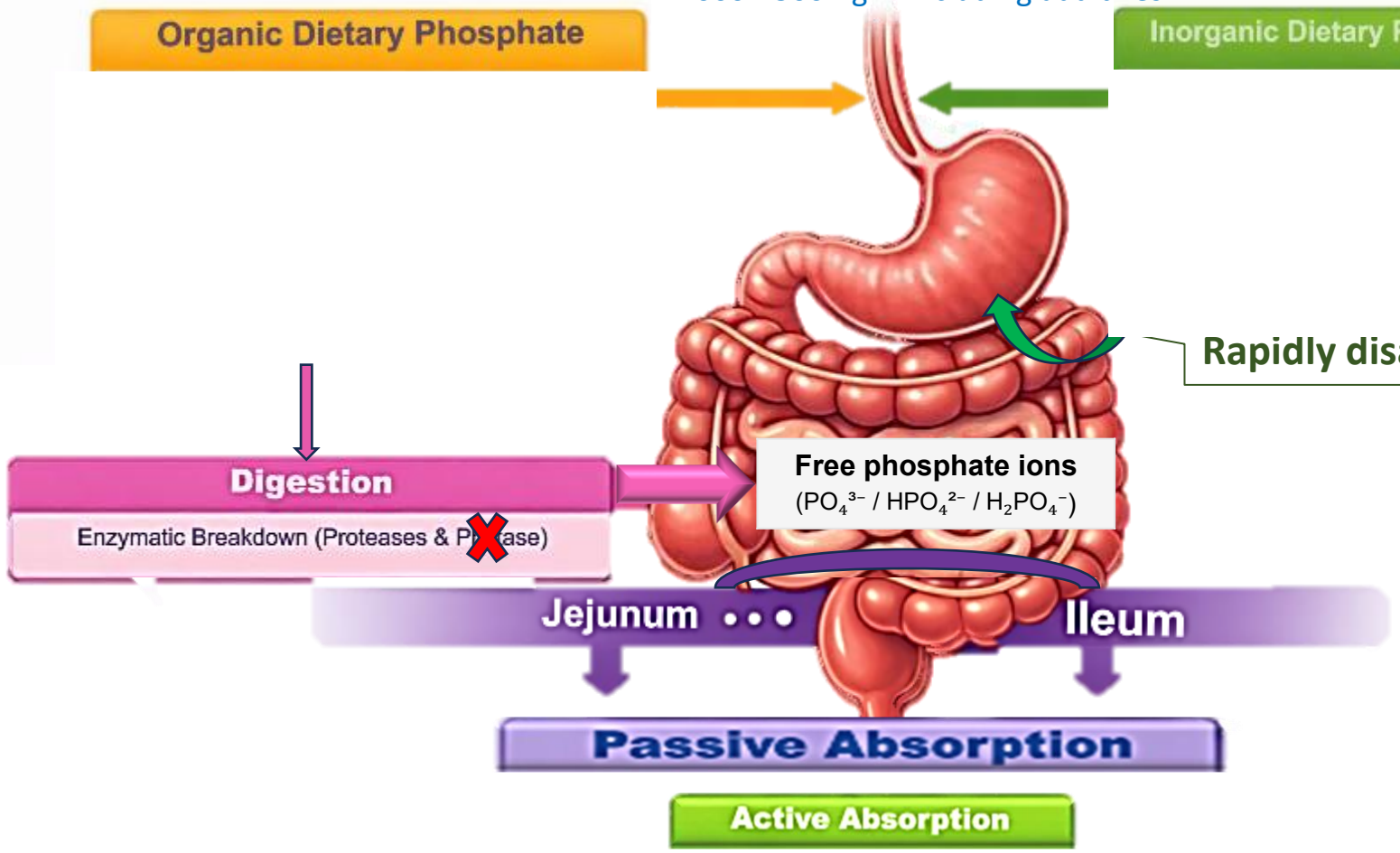
Clayton BE, Jenkins P, Round JM (1980)
Paediatric chemical pathology: clinical tests and references ranges.
Oxford: Blackwell Scientific

- Trends rather than single values
- Not interpreted in isolation
- Haemolysis can increase level (+0.3-0.5mmol/L)

PHOSPHATE DIGESTION AND ABSORPTION

DIETARY PHOSPHATE

1200-1400mg (adults) NDNS
2000-2500mg * including additives



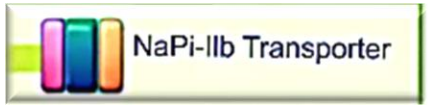
*Barretto 2019

PHOSPHATE ABSORPTION

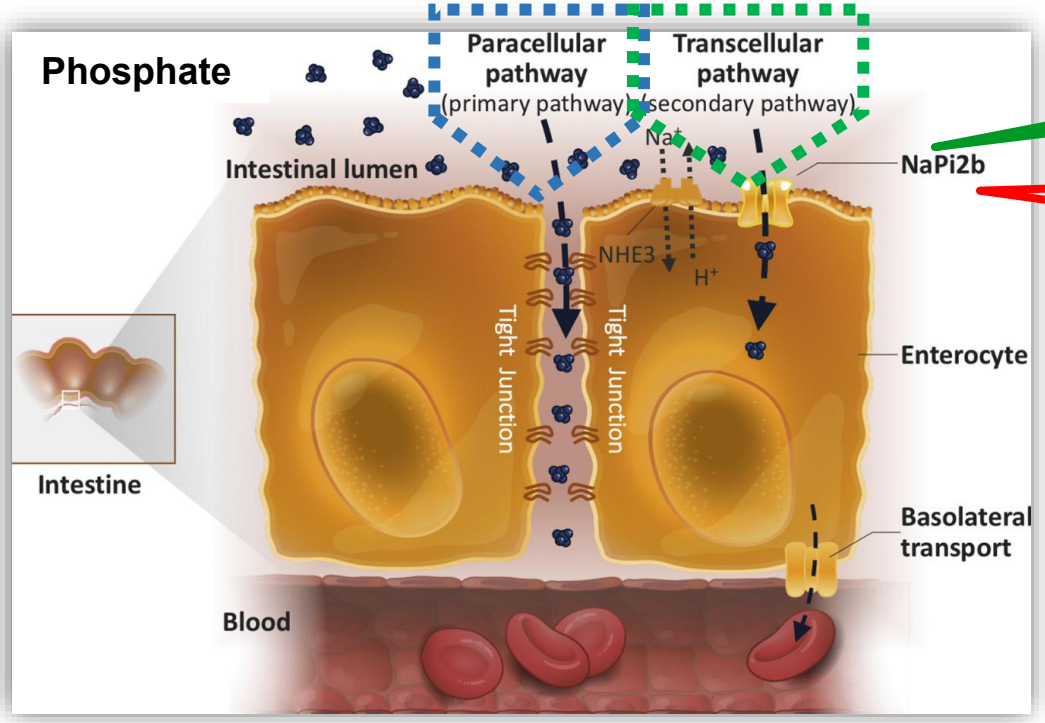
Passive Absorption

Paracellular 70-80% *(concentration-dependent)*

Active Absorption



Transcellular 20–30% *(active, regulated)*



Upregulated by
1,25-dihydroxyvitamin D

Downregulated by
high phosphate intake, **FGF23** & (indirectly) **PTH**

- Serum phosphate can rise **despite maximal hormonal suppression**
- Phosphate binders are effective (they reduce luminal phosphate → ↓ **paracellular flux**)

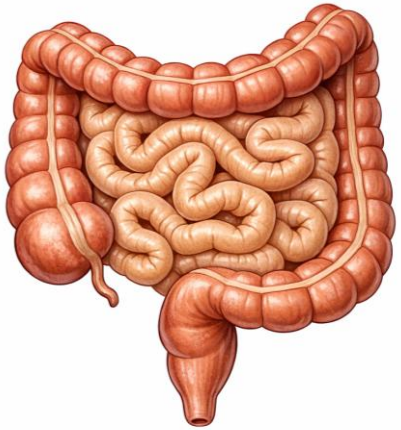
REGULATION OF PHOSPHATE (and calcium) BALANCE

"GATEKEEPERS OF P BALANCE"

ACTIVE VITAMIN D

PTH

FGF 23



OXFORD ERA ndt NEPHROLOGY DIALYSIS TRANSPLANTATION

Nephrol Dial Transplant, 2024, **39**, 190–201

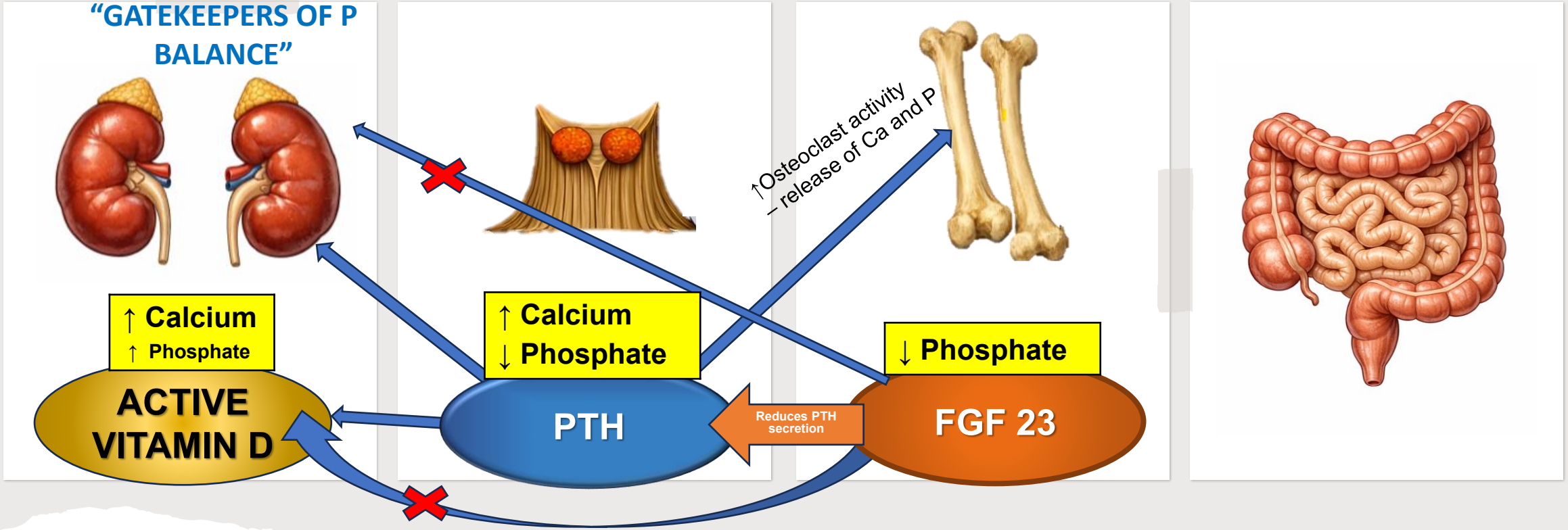
https://doi.org/10.1093/ndt/gfad188

Advance access publication date: 2 September 2023

The basics of phosphate metabolism

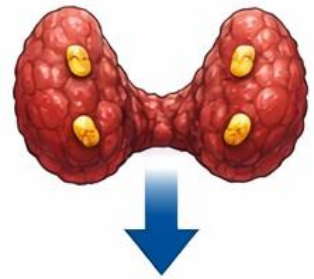
Carsten A. Wagner

REGULATION OF PHOSPHATE (and calcium) BALANCE



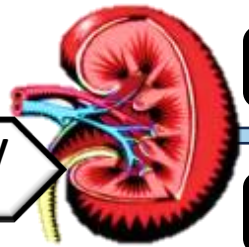
↑ **Intestinal Ca absorption**	**Stimulates 1α-hydroxylase**	**Inhibits** 1α-hydroxylase
↑ **Bone mineralisation**	↑ **Ca reabsorption** in renal **distal tubules**	
↑ Intestinal P absorption	**Downregulates NaPi-2 a/c** transporters in the **proximal tubule** → **phosphaturia**	**Downregulates NaPi-2 a/c** transporters in the proximal tubule → **phosphaturia**

Response to Low Calcium Levels



↑ Parathyroid Hormone (PTH)

WHAT HAPPENS in CHRONIC KIDNEY DISEASE?



Declining kidney function

↓ phosphate excretion

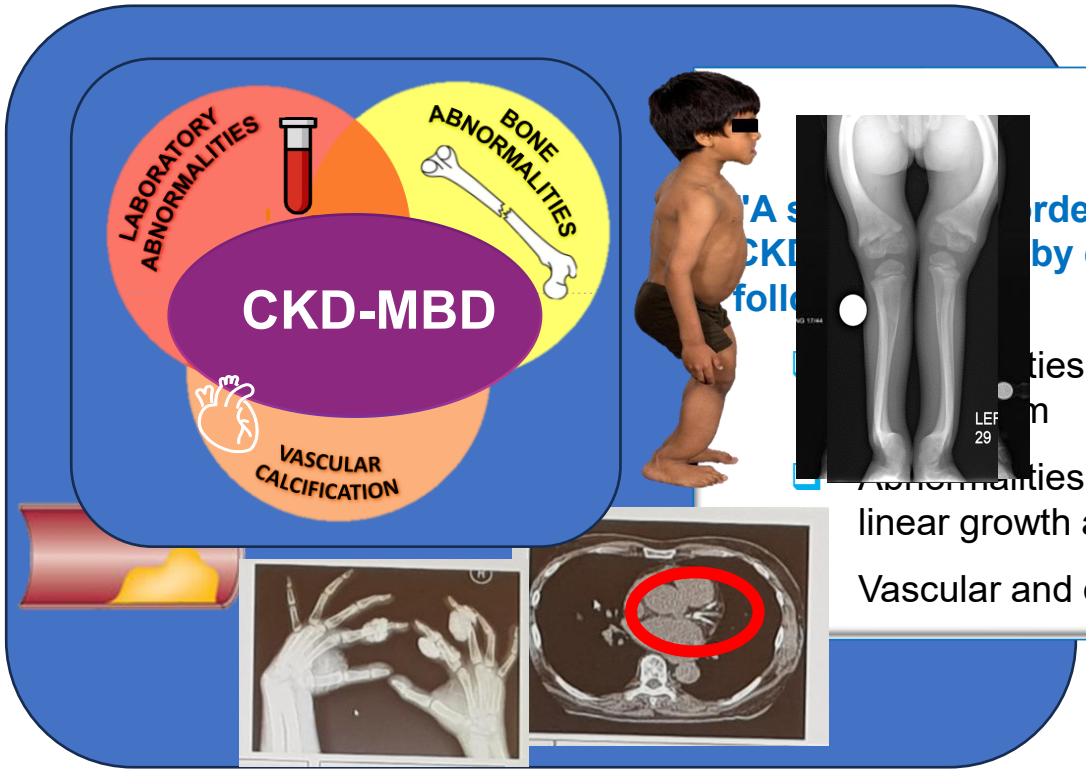
↑ serum phosphate
↑ FGF23 (early)

↓ 1,25(OH)$_2$ vitamin D

↓ calcium absorption
± hypocalcaemia

↑ PTH
(2°hyperparathyroidism)

CKD-MBD

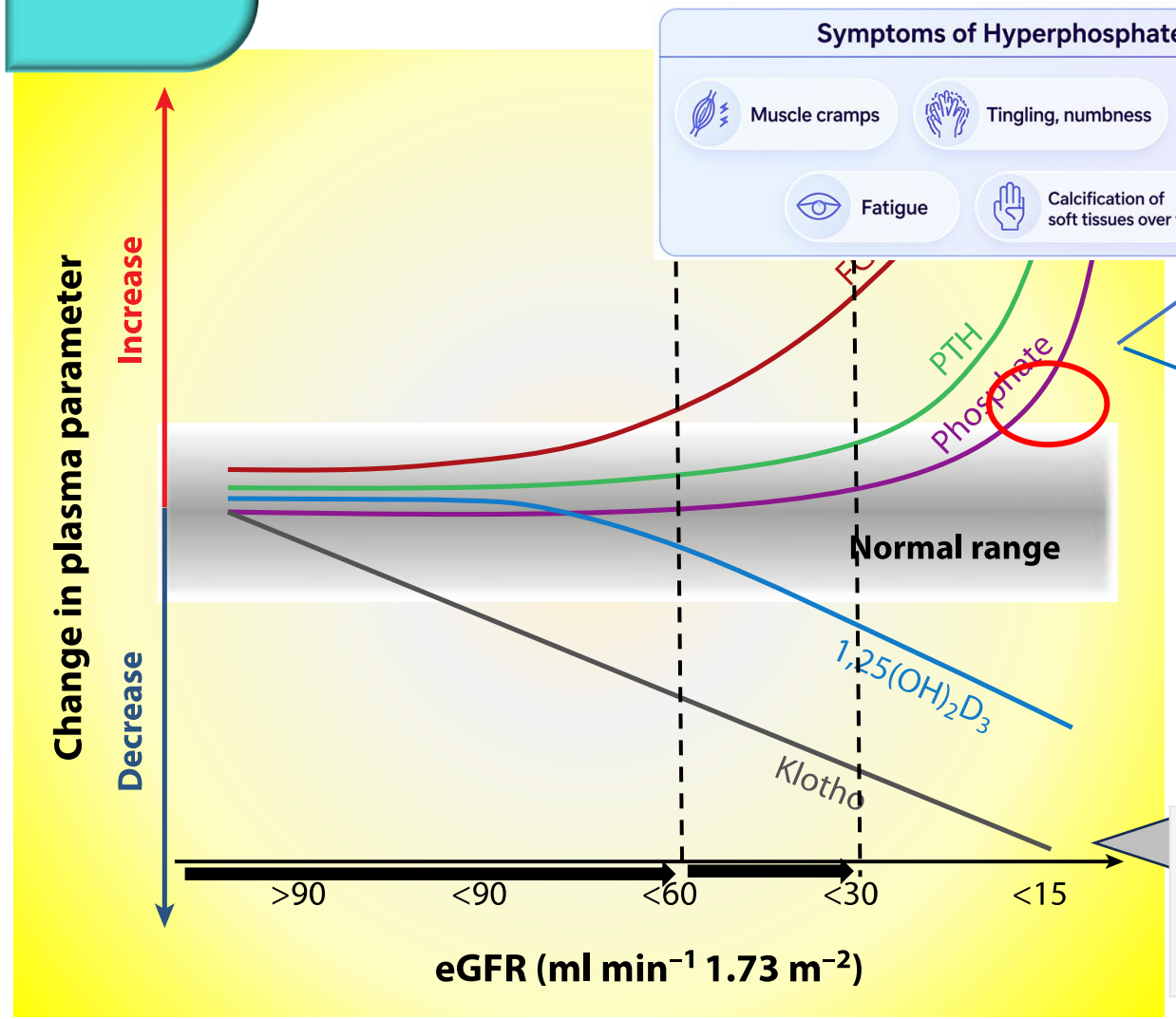


CKD-MBD

"A s… rder of mineral and bone metabolism due to CKD… by either one or a combination of the foll…

- …ties of calcium, phosphorus, PTH & vitamin D …m
- Abnormalities in bone turnover, mineralisation, volume, linear growth and strength
- Vascular and other soft tissue calcification"

BLOOD CHEMISTRY CHANGES with DECLINING KIDNEY FUNCTION



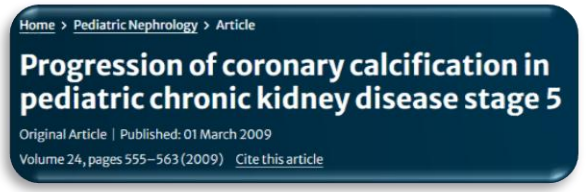
Serum P levels

Determine **progression** of **coronary calcification**

Goodman WG, et al. N Engl J Med 2000;342:1473–83;
Civilibal M, et al. Pediatr Nephrol 2009;24:555–63.


The NEW ENGLAND JOURNAL of MEDICINE

Coronary-Artery Calcification in Young Adults with End-Stage Renal Disease Who Are Undergoing Dialysis


Home › Pediatric Nephrology › Article

Progression of coronary calcification in pediatric chronic kidney disease stage 5

Original Article | Published: 01 March 2009

Volume 24, pages 555–563 (2009) Cite this article

Serum P > 1.97mmol/L

Idependently associated with ↑**fracture risk**

Barrera-Baena , P. et al.Nephrol Dial Transplant 2024
Vol. 39 I(4): 618-626

COSMOS


OXFORD ERA nd t

Nephrol Dial Transplant, 2024, 39, 618–626
https://doi.org/10.1093/ndt/gfad190
Advance access publication date: 2 September 2023

Serum phosphate is associated with increased risk of bone fragility fractures in haemodialysis patients

Pedro Barrera-Baena, Minerva Rodríguez-García, Enrique Rodríguez-Rubio, Lucía González-Llorente, Alberto Ortiz, ...

KLOTHO

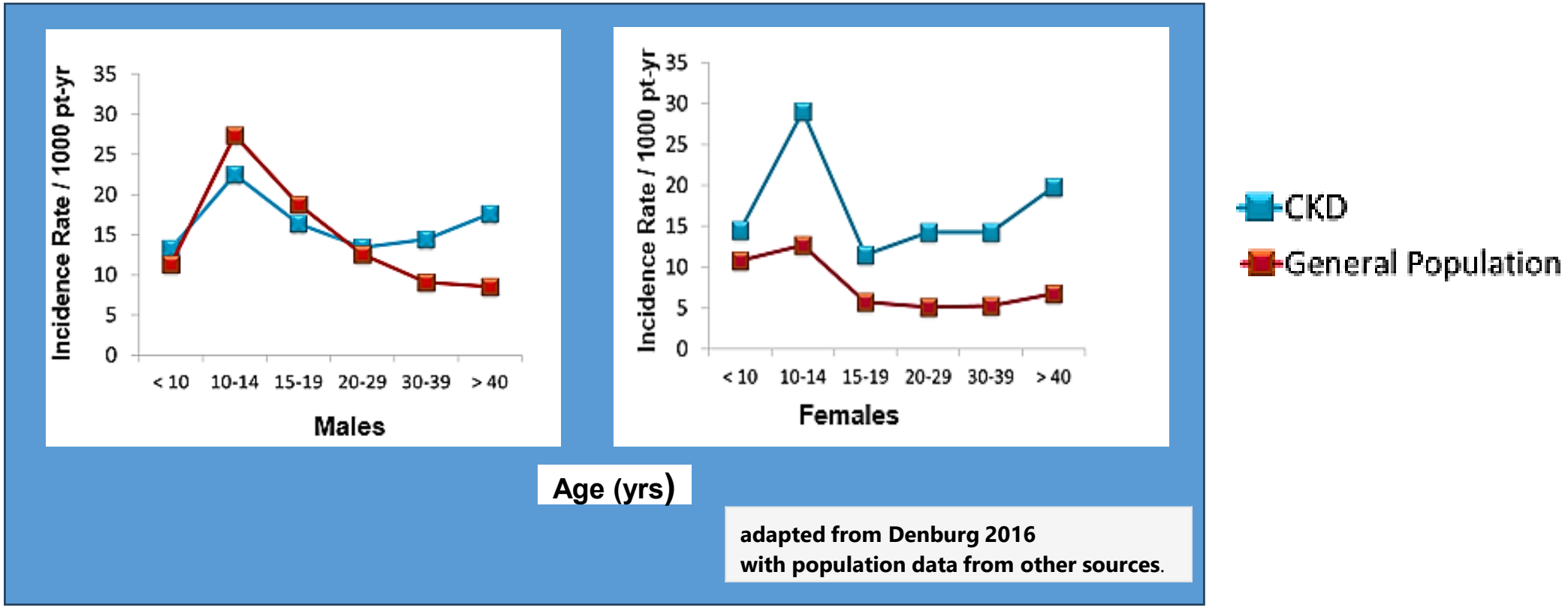
- Co-receptor for FGF23
- Mainly produced by kidney
- ↓ → ↑ FGF23 resistance

Adapted from: Chang Hu et al, Annu Rev Physiol 2013

Chronic Kidney Disease in Children

Fracture rate: 2-3 x higher v general population
Peak in puberty

CKD n = 2000 Controls n = 1 million



adapted from Denburg 2016
with population data from other sources.

FRACTURES IN CHILDREN with CKD - risk factors

Chronic Kidney Disease in Children

JASN

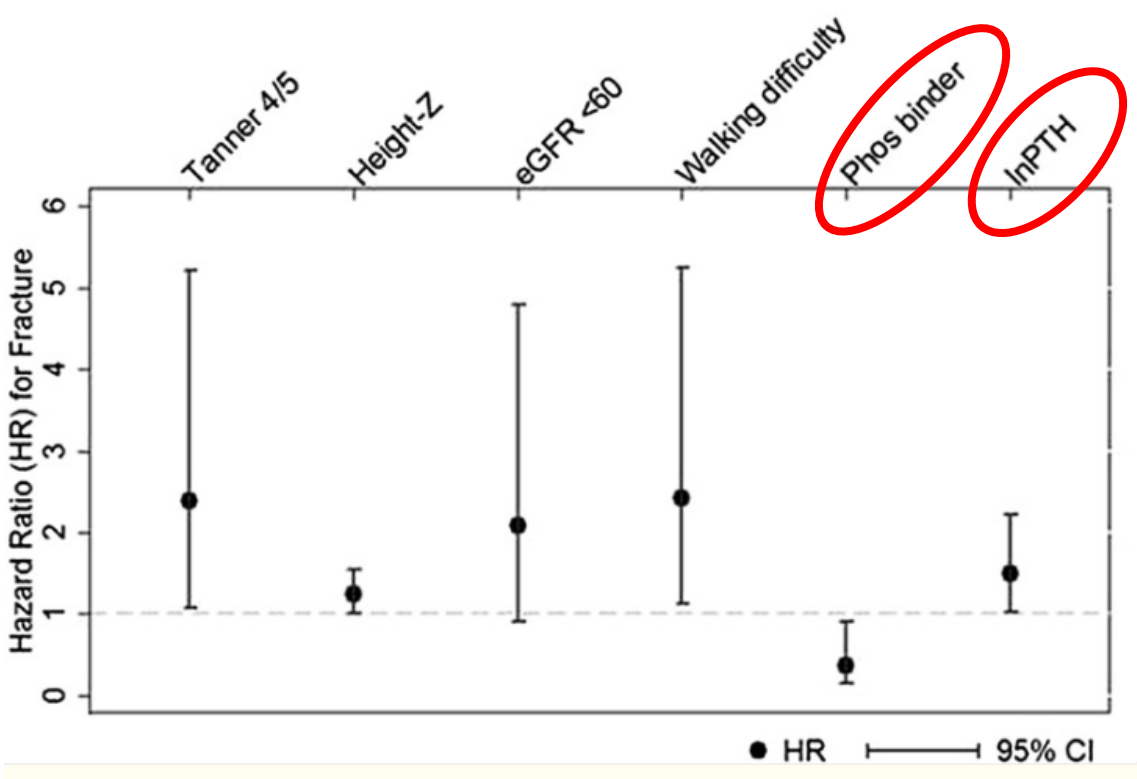
J Am Soc Nephrol. 2015 Jul 2;27(2):543–550. doi: 10.1681/ASN.2015020152

Fracture Burden and Risk Factors in Childhood CKD: Results from the CKiD Cohort Study

Denburg, et al. 2016

- 537 children
- Mild - moderate CKD (83% in CKD stages 2-3)
- Median age 11 years
- ~4-year follow-up

Risk for fractures



FRACTURES IN CHILDREN with CKD – European data

european society for paediatric nephrology
espn

Working group: CKD-MBD and mineral disorders

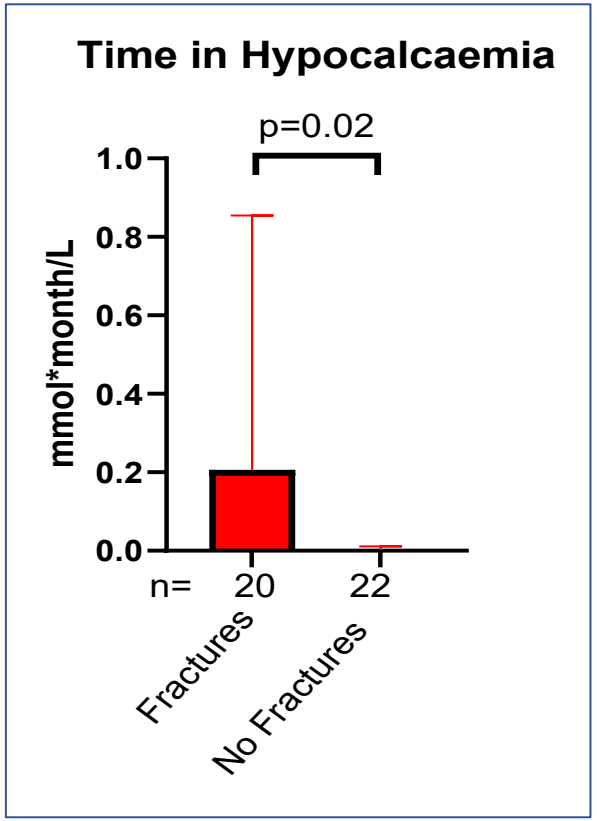
Retrospective data (questionnaire)
Lalayiannis et al (unpublished)

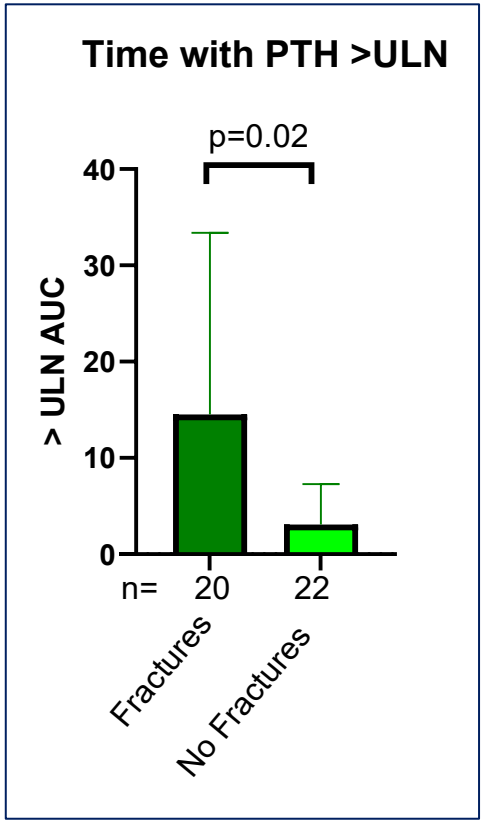
Fractures linked to hypocalcaemia, high PTH and low Ca intake

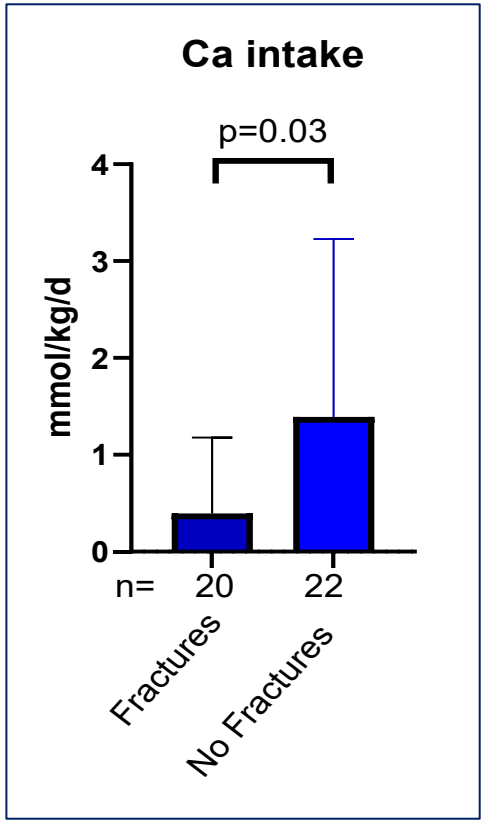
Age at fracture
4.9 yrs (2, 11.2)

How happened	
Falling from standing/tripping	53%

Consequences	
Deformity	37%
Restricted range of movement	27%







CKD PROGRESSION - European data (EQUAL study)

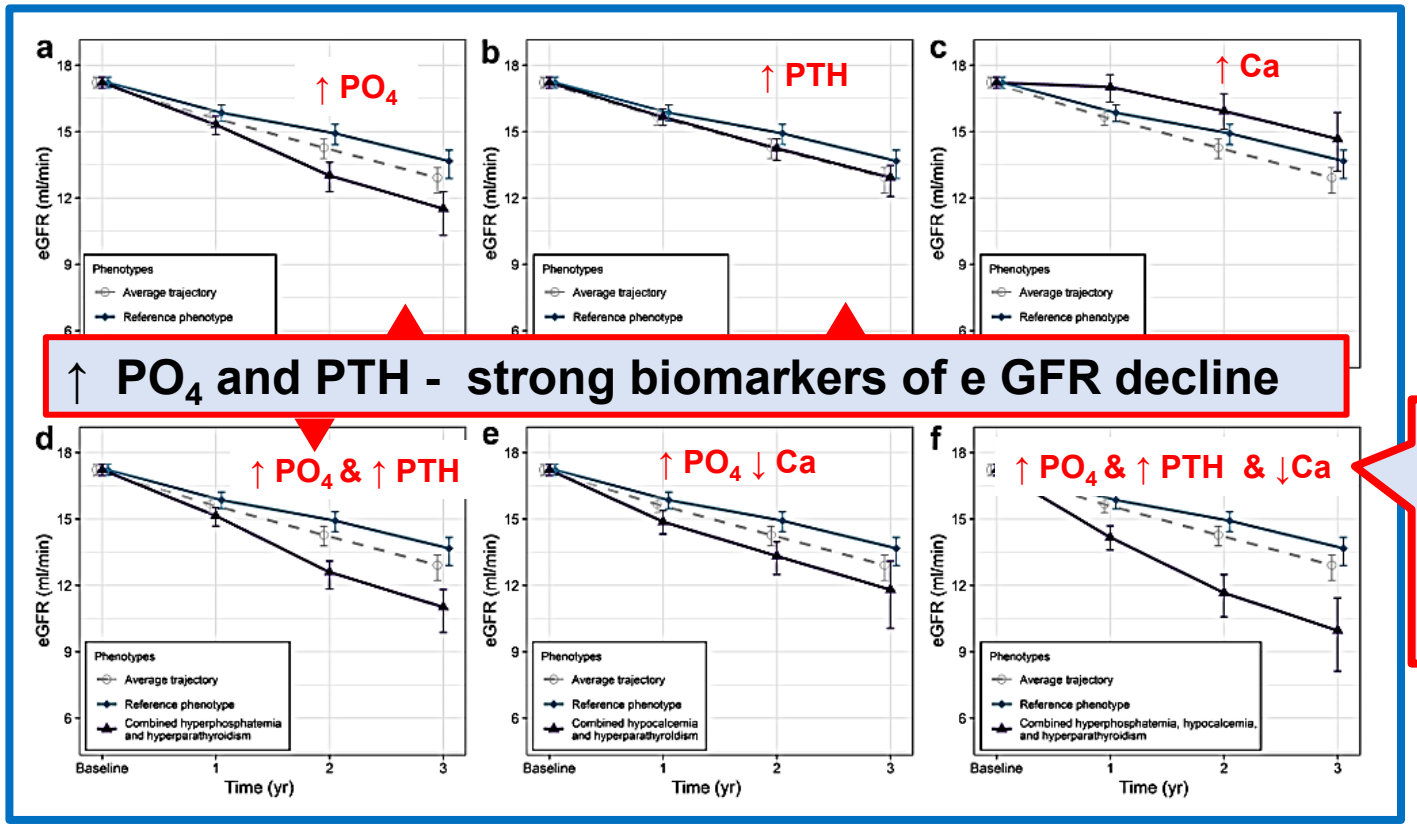
European QUALity study in advanced CKD Magagnoli et al; KI 2025

1709 adults

- Ongoing, prospective, observational cohort study
- > 65 years **GFR < 20ml/min/1.73m²**
- **3 years data**

Average trajectory of decline

Abnormal biochemistry (P, PTH and Ca)



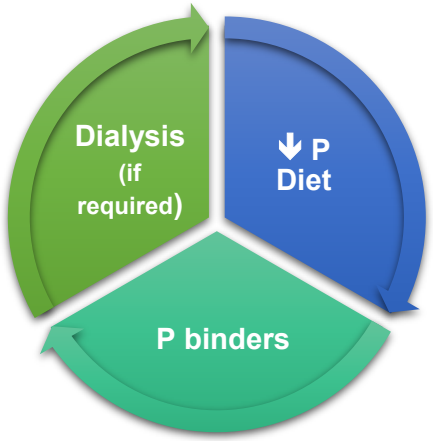
Combined:

↑ PO_4 ↑PTH & ↓Ca

-3.71 ml/min ↓ in eGFR in 3 years

75% higher risk of starting dialysis

CKD GUIDELINES RECOMMENDATIONS: Phosphate



- There are no universally defined paediatric P reference ranges in CKD guidelines
- No absolute biochemical cut offs for P, Ca, PTH
- Use local age-specific reference ranges; interpret biochemistry dynamically
- Serial monitoring/trends
- Integrated interpretation (Ca, P, PTH)
  - P "within range" is not sufficient
  - A phosphate value in the upper normal range or rising – will require intervention

EVOLUTION OF DIETARY PHOSPHATE MANAGEMENT IN CKD

'Phos'tering a clear message: the evolution of dietary phosphorus management in chronic kidney disease

Biruete, A., et al. *J Ren Nutr,* 2023

Quantative (mg/100g or per serving)

P density (mg/kcal)

P:Protein ratio

Phosphatemic index (Narasaki, 2020)

Research-based

- **BIOACCESSIBILITY** Released from food matrix
- **BIOAVAILABILITY** Actually absorbed

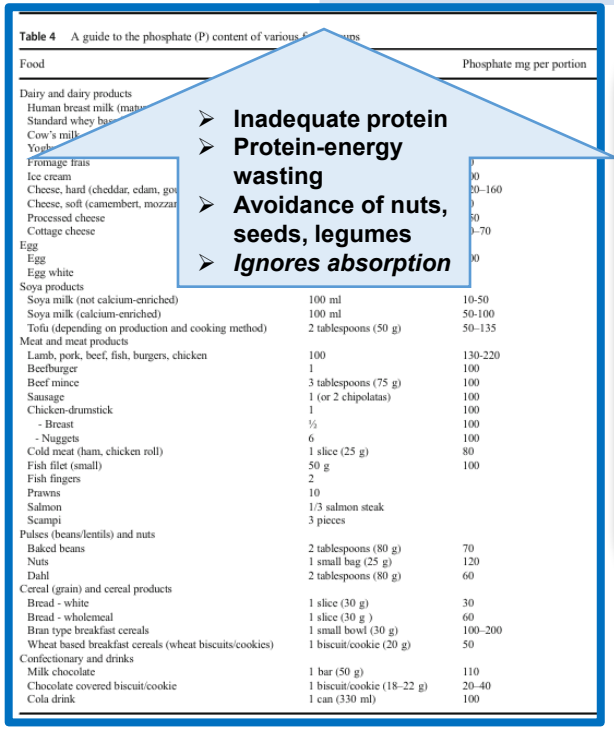
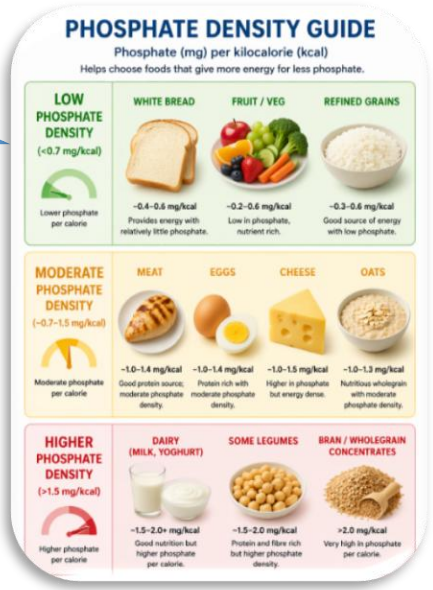


Table 4 A guide to the phosphate (P) content of various foods

Food		Phosphate mg per portion
Dairy and dairy products		
Human breast milk (matu		
Standard whey bas		
Cow's milk		
Yogh		
Fromage frais		
Ice cream		00
Cheese, hard (cheddar, edam, go		20–160
Cheese, soft (camembert, mozza		0
Processed cheese		50
Cottage cheese		0–70
Egg		
Egg		00
Egg white		
Soya products		
Soya milk (not calcium-enriched)	100 ml	10-50
Soya milk (calcium-enriched)	100 ml	50-100
Tofu (depending on production and cooking method)	2 tablespoons (50 g)	50–135
Meat and meat products		
Lamb, pork, beef, fish, burgers, chicken	100	130-220
Beefburger	1	100
Beef mince	3 tablespoons (75 g)	100
Sausage	1 (or 2 chipolatas)	100
Chicken-drumstick	1	100
- Breast	½	100
- Nuggets	6	100
Cold meat (ham, chicken roll)	1 slice (25 g)	80
Fish filet (small)	50 g	100
Fish fingers	2	
Prawns	10	
Salmon	1/3 salmon steak	
Scampi	3 pieces	
Pulses (beans/lentils) and nuts		
Baked beans	2 tablespoons (80 g)	70
Nuts	1 small bag (25 g)	120
Dahl	2 tablespoons (80 g)	60
Cereal (grain) and cereal products		
Bread - white	1 slice (30 g)	30
Bread - wholemeal	1 slice (30 g)	60
Bran type breakfast cereals	1 small bowl (30 g)	100–200
Wheat based breakfast cereals (wheat biscuits/cookies)	1 biscuit/cookie (20 g)	50
Confectionary and drinks		
Milk chocolate	1 bar (50 g)	110
Chocolate covered biscuit/cookie	1 biscuit/cookie (18–22 g)	20–40
Cola drink	1 can (330 ml)	100

- **Inadequate protein**
- **Protein-energy wasting**
- **Avoidance of nuts, seeds, legumes**
- ***Ignores absorption***

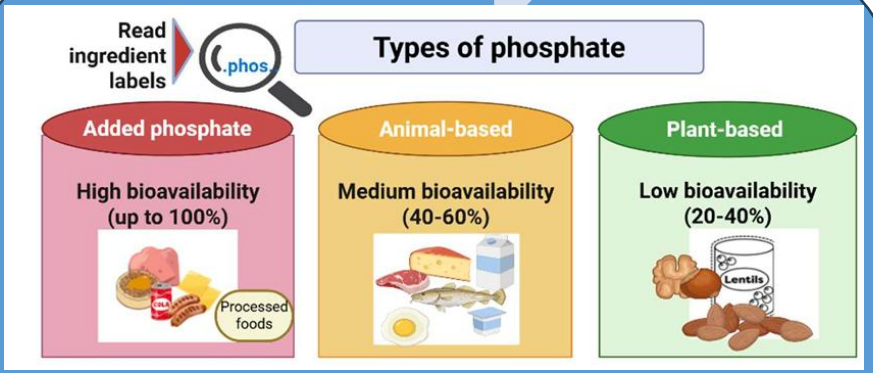
McAlister et al., *Pediatr Nephrol* 2020



P-to-protein ratio	Serving	P (mg)	Protein (g)	P : Protein ratio (mg/g)
Low (<5mg/g)				
Egg white	1 large	5	3.6	1.4
5-<10 mg/g)				
Meat (eg lamb)	90g	170	27	6.3
Tuna (tinned)	90g	139	21.7	6.4
10-15 (mg/g)				
Salmon	90g	235	23.2	10.1
Whole egg	1	84	6.3	13.3
15-25 (mg/g)				
Peanuts	30g	101	6.7	15.1
Kidney beans	70g	125	7.7	16.2
Cheddar cheese	30g	145	7.1	20.4
25 (mg/g)				
Low fat milk	240ml	229	8.1	28.3
Cashews	30g	139	4.3	32.3
Sunflower seeds	25g	370	6.2	59.7

Adapted from: Kalantar-Zade, K et al 2010

Aiming for **low P:protein ratio** to ensure adequate protein



Polderman, N. et al, *Clinical Kidney Journal*, 2026

E338 Phosphoric acid
E339 Sodium phosphate
E340 Potassium phosphate
E341 Calcium phosphate
E343 Magnesium phosphate
E450 Diphosphate
E451 Triphosphate
E452 Polyphosphate

Or "PHOS"

DIETARY PHOSPHATE MANAGEMENT IN CKD

PAEDIATRIC RENAL NUTRITION TASKFORCE

Pediatric Nephrology (2020) 35:501–518
https://doi.org/10.1007/s00467-019-04370-z

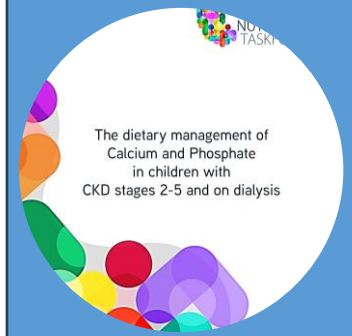
GUIDELINES

The dietary management of calcium and phosphate in children with CKD stages 2-5 and on dialysis—clinical practice recommendation from the Pediatric Renal Nutrition Taskforce

Louise McAlister[1] · Pearl Pugh[2] · Laurence Greenbaum[3] · Dieter Haffner[4] · Lesley Rees[1] · Caroline Anderson[5] · An Desloovere[6] · Christina Nelms[7] · Michiel Oosterveld[8] · Fabio Paglialonga[9] · Nonnie Polderman[10] · Leila Qizalbash[11] · José Renken-Terhaerdt[12] · Jetta Tuokkola[13] · Bradley Warady[14] · Johan Vande Walle[6] · Vanessa Shaw[1,15] · Rukshana Shroff[1]

https://www.espn-online.org/nutrition-taskforce/

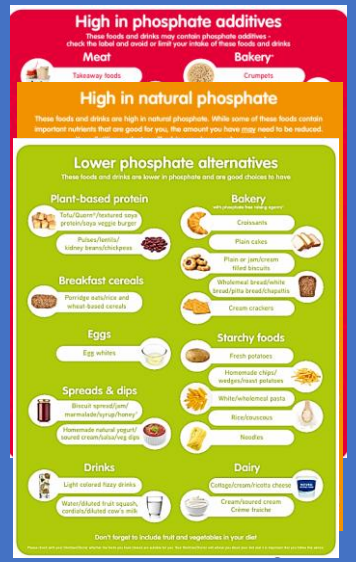
Practical guides *Health care professionals*



www.vitaflo-VIA.com

Patient resources

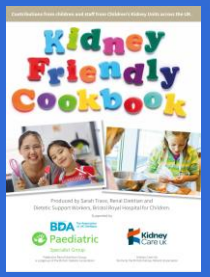
www.vitaflo-VIA.com



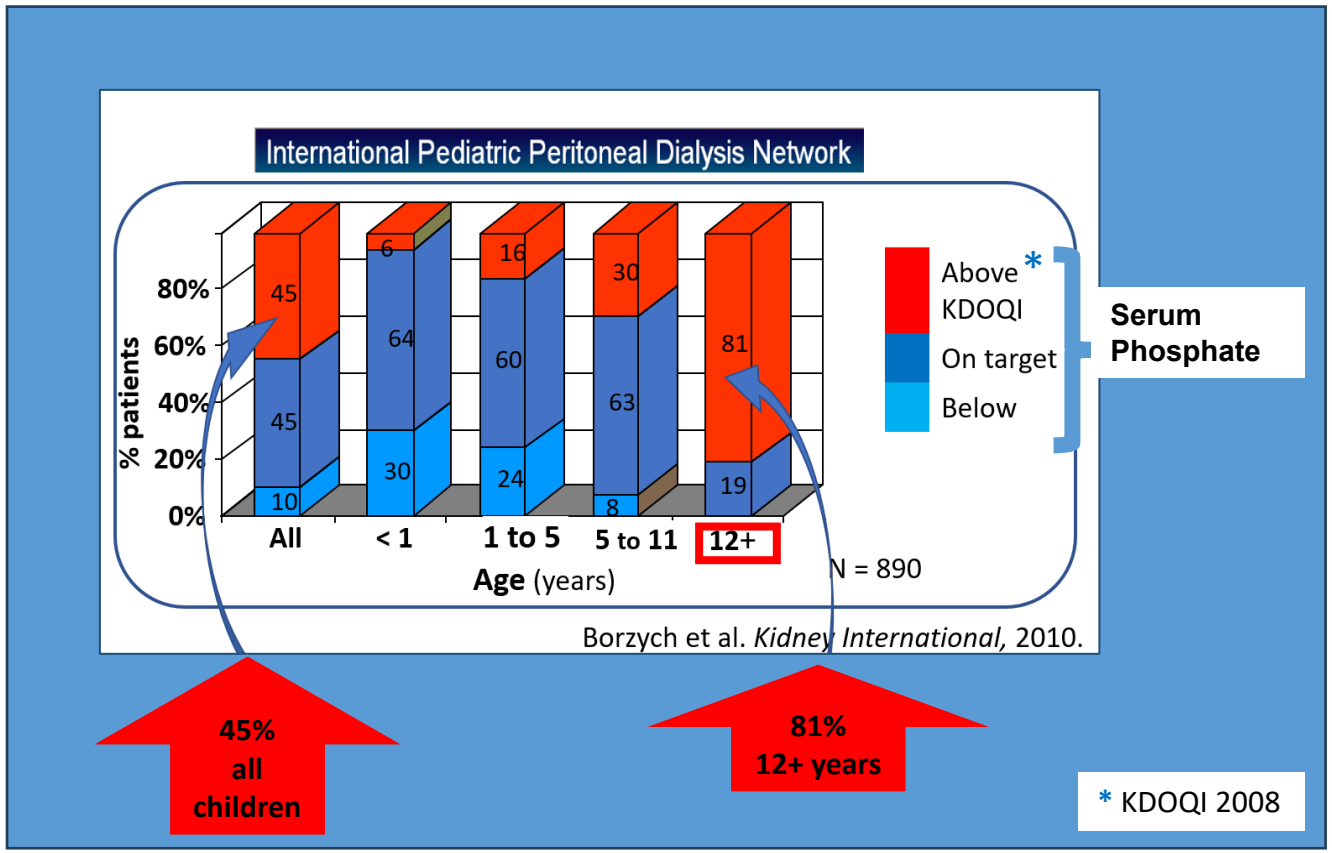
www.myrenalnutrition.com

My Renal Nutrition

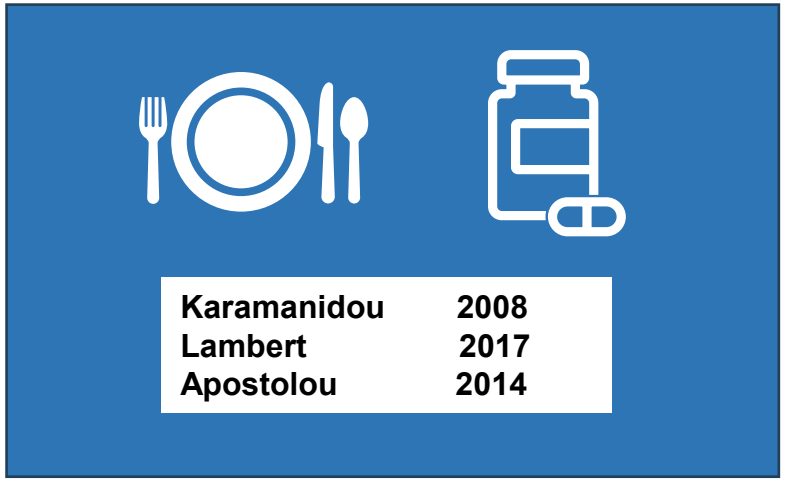
Kidney Care UK



High serum P is common in children with CKD



Adherence is under 50%



DIETARY PHOSPHATE EDUCATION

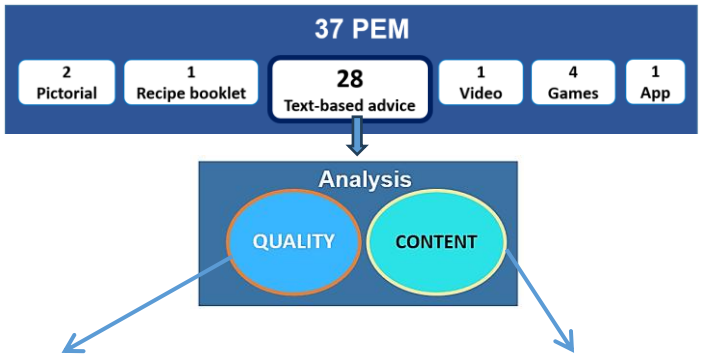
IMPACT STUDY

ORIGINAL RESEARCH

Dietary Phosphate Educational Materials for Pediatric Chronic Kidney Disease: Are Confused Messages Reducing Their Impact?

Louise McAlister, BSc, RD, MBDA, Vanessa Shaw, MA, PG Diploma Dietetics, RD, FBDA,† and Rukshana Shroff, MD, FRCPCH, PhD†‡*

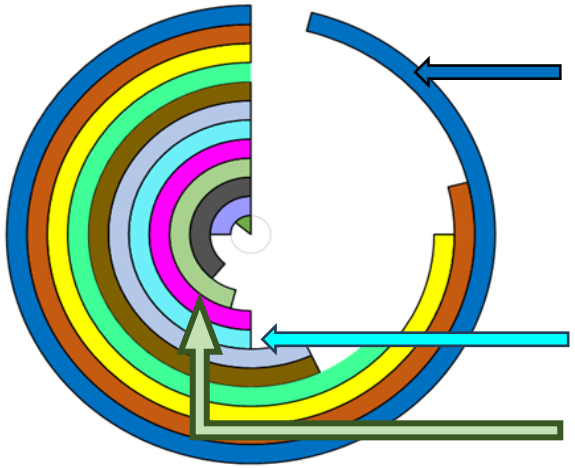
Journal of Renal Nutrition 2024



- **Reading age / ease**
- **Date of production**
- **Validated tools for:**
  Understandability/actionability
  "SAM" Doak, Doak 1996
  "PEMAT-P" Shoemaker 2014

- **Content analysis**
  Compared to PRNT
- **Inconsistencies + inaccuracies**

CONTENT



	PEMs (%)
↓ Milk	96
↓ Nuts	79
↓ Dairy	75
↓ Eggs	64
↓ "High protein foods"	57
↓ Fish with bones	57
↓ P raising agents	50
↓ Seeds	50
↓ Legumes	46
↓ Wholegrains	39
Consider special products	25
↑ Plant based	14

~ 20% >5 years

PAEDIATRIC RENAL NUTRITION TASKFORCE

KEY PRNT

- LIMIT
- REDUCE (high P)
- Low P
- No recommendation

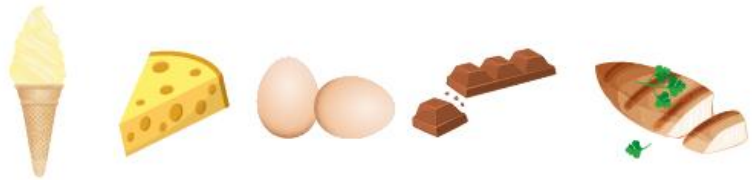
INCONSISTENCIES / INACCURACIES (36%)

- Advice to avoid foods that are not high in phosphate
- Advice to encourage high fat foods such as cheese *(which would increase phosphate intake)*
- Conflicting advice on certain fruits and vegetables
- Inclusion of alcohol advice despite designed for children
- Inclusion of advice about potassium restriction
- Foods on both allowed and forbidden list within same PEM
- Confusing / inaccurate colour coding
- Spelling mistakes

Step 1 **Limit phosphate additives**

Choose fresh foods rather than processed foods

Step 2 **Reduce intake of some foods naturally high in phosphate**



Step 3 **Replace some of the naturally occurring animal-based phosphate foods with plant-based foods**

Promote home-cooked foods
Minimise intake of low nutritional value foods

Phosphate additives

Roles: preservatives, raising agent, enhance colour / moisture / flavour

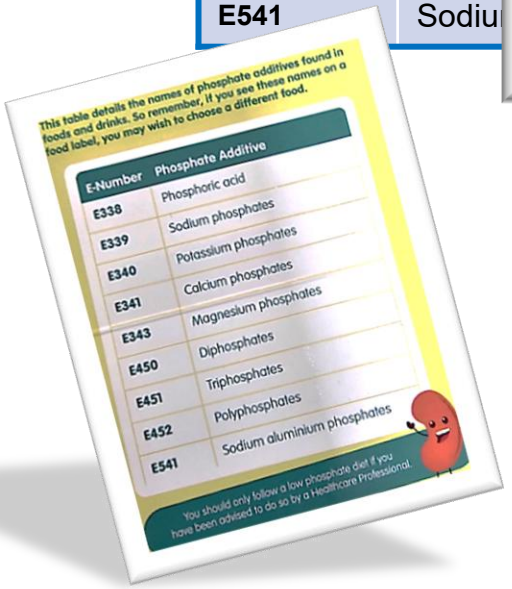
E-Number	Phosphate Additive
E338	Phosphoric acid
E339	Sodium phosphate
E340	Potassium phosphate
E341	Calciu
E343	Magne
E450	Dipho
E451	Tripho
E452	Polypl
E541	Sodiu

1. **Absorption >90%**
2. **Can increase P content by >50%**
   EFSA 2019 quotes exposure levels from international surveys [6-30%]
3. **Manufacturers are not legally required to list the total P content**
4. **Not included in nutrient databases / dietary assessment software packages**

Cola & dark fizzy drinks
phosphoric acid as acidulant

Processed meats:
ham, bacon, sausages, burgers

, instant noodles



Ingredients:
Raising Agents
E 450 (Diphosphates)
E 500 (Sodium Carbonates)
Maize Starch

Ingredients:
Wheat Flour (Wheat Flour, Calcium Carbonate, Iron, Thiamine, Niacin), Sugar, Palm Oil, Glucose Syrup, Colours: Safflower Concentrate, Radish Concentrate, Apple Concentrate, Blackcurrant Concentrate, Carrot Concentrate, Hibiscus Concentrate, Salt, Partially Inverted Refiners Syrup, Raising Agents: Sodium Bicarbonate, Ammonium Bicarbonate, Disodium Diphosphate, Glycerine, Flavouring, Emulsifier: Soya Lecithin, Hydrolysed Wheat Gluten, Acidity Regulators: Citric Acid

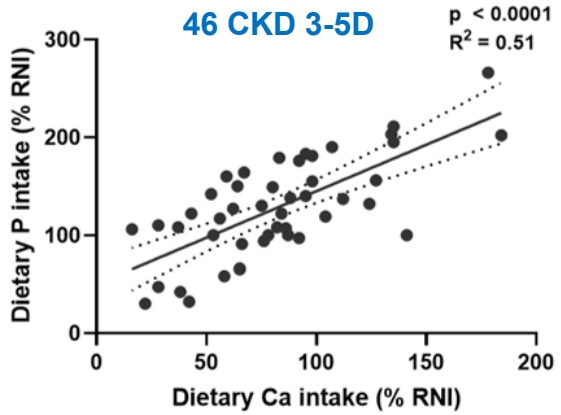
Phosphate portions

Portions

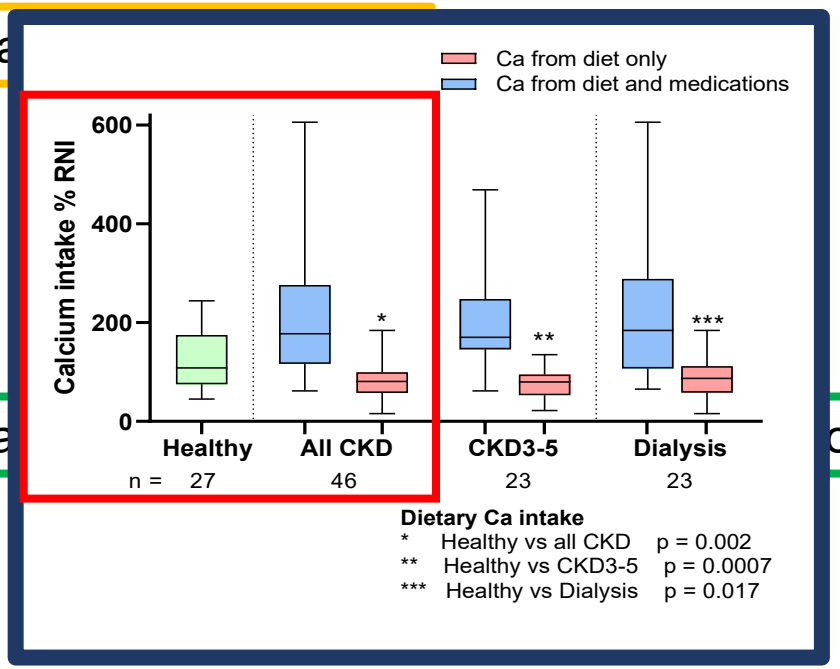
1 egg	150g crème fraiche
100ml milk	½ pot natural yogurt (60g)
80ml cheese sauce (5 tablespoons)	1 pot custard or rice pudding (125g)
1 thin slice or I heaped table-spoon cheddar cheese (20g)	2 scoops ice cream (120g)
1 small portion camembert or brie (30g)	1 small chocolate covered biscuit bar (50g)
1 pot fromage frais (85g) or fruit yogurt (120g) or soya yogurt (120g)	½ mini pizza (50g)

Dietary Ca & P intake (%RNI)

McAlister et al (2020) Pediatric Nephrology 35: 1915-1923



Reduce animal- ba



ods

Ca intake

- **81% RNI in CKD** vs **108% for healthy** (p=0.002)
- **76% CKD** had an intake <100%RNI

Calcium

Bread
Fortified non dairy milk products
Ca fortified orange juice
Fish with bones
Kale
Baked beans
Phosphate binders
Ca fortified cereals

Step 3 Replace some of the naturally occurring animal-based phosphate foods with plant-based foods

Plant P
less bioavailable

↑ **Availability**: phytic acid (seeds , wholegrains , nuts and legumes)
Processing –refine grains, boiling, soaking, fermenting, gut microbiome

Moe et al
Clin J Am Soc Nephrol. 2011;6(2):257-264.

- Randomised crossover trial
- 9 adults with CKD 3-4 (mean eGFR 32)
- 7-day vegetarian diet v 7 day meat-based (same protein, energy, Ca and P intake)
- Lower serum phosphate levels & FGF-23

Less P additives
From processed foods

Plant Slant diet

ACIDOSIS

Growth failure
Supresses the GH-IGF-1 axis

Bone disease
↑Bone resorption & impaired mineralisation

Muscle wasting
↑ Muscle protein breakdown

Faster CKD progression

↓Renal acid load

↑ Fibre
Alter gut microbiome
→ ↑ anti-inflammatory compounds
↓ uraemic toxins

Plant-based diets: a fad or the future of medical nutrition therapy for children with chronic kidney disease?
Educational Review | Published: 14 February 2023

No paediatric data to support link to ↓CKD progression.
Including CKiD 2022

kidney INTERNATIONAL 2024
KDIGO KIDNEY DISEASE · IMPROVING GLOBAL OUTCOMES
KDIGO 2024 Clinical Practice Guideline for the Evaluation and Management of Chronic Kidney Disease

3.3 Diet Practice Point:
Advise people with CKD ….**higher consumption of plant-based foods** compared to animal-based foods

KDOQI
KIDNEY DISEASE OUTCOMES QUALITY INITIATIVE
National Kidney Foundation
eat right Academy of Nutrition and Dietetics

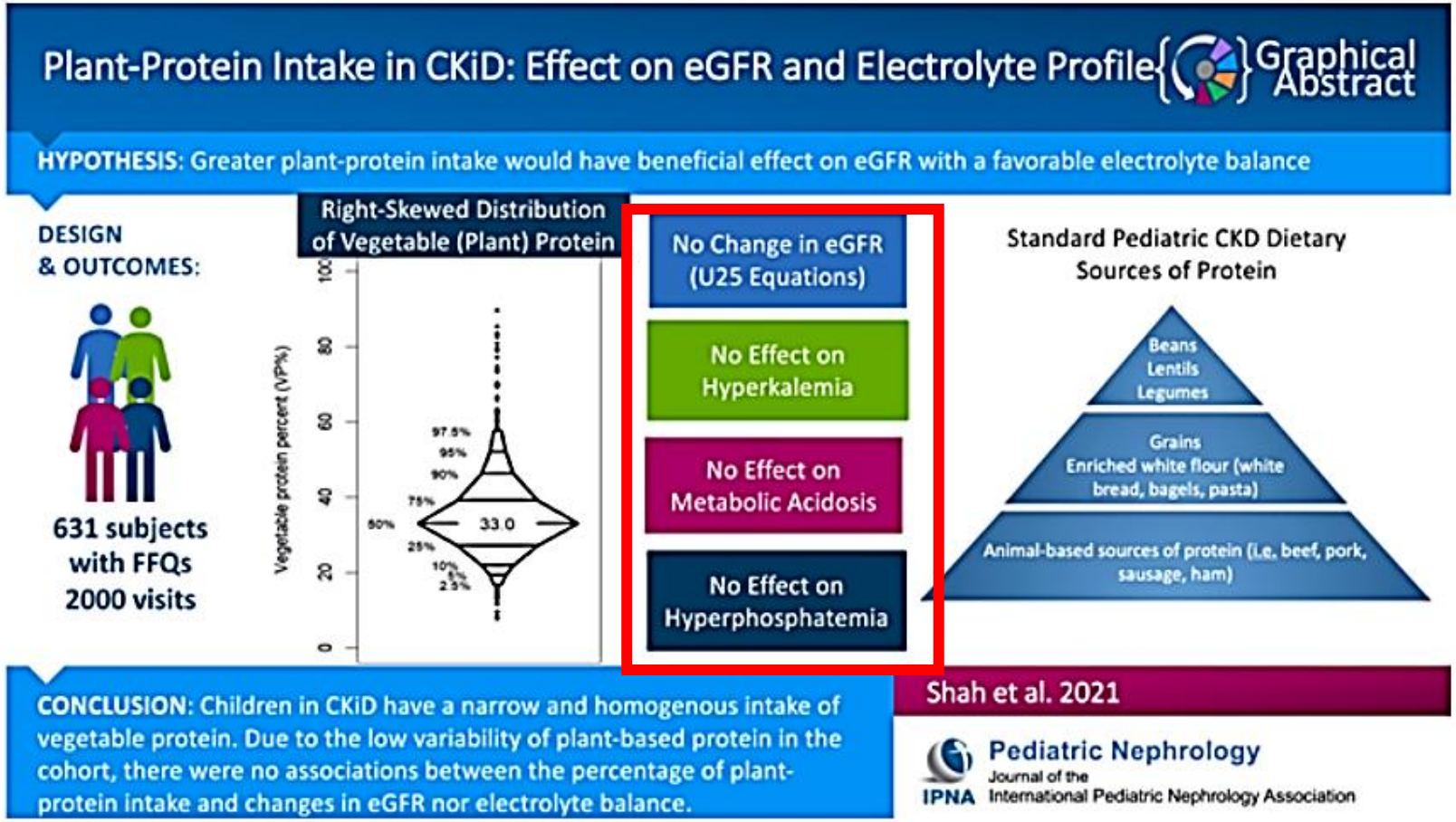
KDOQI CLINICAL PRACTICE GUIDELINE FOR NUTRITION IN CKD: 2020 UPDATE

T. Alp Ikizler, Jerrilynn D. Burrowes, Laura D. Byham-Gray, Katrina L. Campbell, Juan-Jesus Carrero, Winnie Chan, Denis Fouque, Allon N. Friedman, Sana Ghaddar, D. Jordi Goldstein-Fuchs, George A. Kaysen, Joel D. Kopple, Daniel Teta, Angela Yee-Moon Wang, and Lilian Cuppari

Published in final edited form as:
Pediatr Nephrol. 2022 July ; 37(7): 1647–1655. doi:10.1007/s00467-021-05334-y.

Low variability of plant protein intake in the CKiD cohort does not demonstrate changes in estimated GFR nor electrolyte balance

Lokesh N. Shah[1,2], Matthew B. Matheson[3], Susan L. Furth[4,5], George J. Schwartz[6], Bradley A. Warady[7,8], Cynthia J. Wong[1,2]



PAEDIATRIC RENAL NUTRITION TASKFORCE

Step 3 Eat more plant-based foods

Plant-based foods provide important vitamins, minerals and fiber and the phosphate in these foods is less well absorbed. Here are some ideas to increase the plant-based foods in your child's diet:

Replace some of the meat in Bolognese sauce, chilli con carne, burgers and burritos with lentils or beans

Add extra fresh, frozen or canned vegetables to pasta sauces, curries and stews and cut down on the amount of meat, chicken or fish you give

Reduce the amount of meat, fish, eggs or cheese in your child's sandwich filling and replace with hummus or mashed avocado; add some salad items such as cucumber or lettuce

Pack some raw vegetables into your child's lunch box, or give as a snack e.g. carrots, bell peppers, broccoli or cauliflower

Include a side salad with your child's meals e.g. bulgar wheat, quinoa, couscous or rice with added seeds, nuts, celery, radishes, spring onions or sweetcorn

	Step 1. Limit phosphate additives	Step 2. Reduce intake of some foods naturally high in phosphate	Step 3. Give more plant-based foods and choose lower phosphate alternatives
	High in phosphate ADDITIVES	**High in NATURAL phosphate**	**Lower phosphate alternatives**
Milks	Ultra-high temperature (UHT) milk products Non-dairy creamer Plant-based milks containing a phosphate additive	Cow's milk - whole and semi-skimmed, condensed and powdered milk	Dilute cow's milk with water (50:50) Milk substitutes, including some plant-based milks such as oat milk and almond milk†
Dairy	Processed cheese slices/ strips/cheese spread	Hard cheese e.g. cheddar, edam Yogurt Ice cream	Cottage, cream or ricotta cheese Plant-based cheeses Vegan, coconut or soya oil cheese Cream, soured cream Jelly, sorbet, fruit lollies
Bakery	Baked goods or puddings with phosphate-containing raising agents e.g. crumpets, muffins, scones, pastries, naan bread and tortillas/ wraps Baked savoury foods e.g. meat pastries, cheese bread, pizza	Foods containing chocolate	Baked goods without phosphate-containing raising agents* e.g. croissants, Engli muffins and hot cross buns Plain or jam/cream-filled biscuits, plain cakes, teacake cream cakes and doughnuts Cream crackers, wholemeal or white bread, pitta bread, chapattis, rice cakes

Wake up:	1 glass of semi-skimmed milk.
Breakfast:	Scrambled egg + tomato on toast
Morning snack:	Peach Packet of potato crisps
Lunch:	Fish fingers, chips and peas/corn or salami and cheese sandwich
Afternoon Snack:	Chocolate digestive biscuit 100ml orange juice
Evening Meal:	Home-cooked Caribbean stew with potatoes or rice Yogurt
Nutritional supplement:	**Oral nutritional supplement** – 200ml

1) Dilute whole milk
2) Reduce quantity/frequency
3) Swap to oat milk

1 x egg + 1 x egg white to make scrambled eggs

Check label for phosphate additives

? Choose **cold meat**

Lower PO4 cheese eg: mozzarella, cream cheese or vegan cheese

Plain digestives or NICE, Rich Tea or jam biscuits

Or replace with nuts

Check portion size of meat – can this be reduced.?
Can they have more carbohydrates / veg at this meal?

Lower phosphate supplement

PAEDIATRIC RENAL NUTRITION TASKFORCE

Phosphate Swaps

The best way to reduce your intake of phosphate is to cook at home using fresh ingredients rather than having ready meals and takeaways. **Check the labels on processed foods and choose items which do not contain phosphate additives.** The table below shows other swaps that you can make to your diet to help reduce your phosphate intake.

High phosphate foods	Alternative lower phosphate foods
Cow's milk; evaporated, condensed, UHT and powdered milk; plant-based milks fortified with phosphate additives	Dilute cow's milk 50:50 with water; plant-based milks with no phosphate additives, low protein milk alternatives*
Takeaway or packaged beef burgers, chicken nuggets, popcorn chicken, sausages, bacon, ham, salami, meat paste or pate	Most fresh, unprocessed beef, lamb, chicken, pork, duck and turkey; homemade sausages freshly made in the butcher's shop; homemade beef burgers and meatballs; replace some meat with beans, lentils, tofu or tempeh
Fish fingers, fish cakes, battered or crumbed fish, fish paste	Unprocessed fresh, frozen or canned cod, haddock, salmon, tuna, mackerel, sardines, pilchards
Frozen, chilled and dried potato products such as potato waffles and chips	Fresh potatoes, homemade chips and wedges, roast potatoes, rice, couscous, noodles, pasta, bulgar wheat, quinoa
Shop bought naan bread, tortillas	Granary, wholemeal or white bread and rolls; pitta bread, chapattis, wraps, bagels, breadsticks, crumpets, brioche, croissants - check for phosphate additives
Breakfast cereals with chocolate	Porridge oats, rice and wheat-based cereals, multigrain cereals
Packet sauces, instant pasta, noodle dishes, dried cheese or white sauce mixes	Pasta, rice, noodles with homemade sauces/ flavourings
Biscuits, muffins, scones, pastries with chocolate	Plain or jam/cream filled biscuits, teacakes, cream crackers, rice cakes, unsalted popcorn

*Low protein milk alternatives need to be recommended by your Doctor or Dietitian

Plant-based foods

Ingredients

Spring Water, **Almonds** (2%), Calcium Carbonate, Sea Salt, Emulsifier (Sunflower Lecithin), Stabiliser (Gellan Gum), Natural Flavouring, Vitamins (D2, E, B12)

Infant feeding

Per 100ml (standard dilution)	Calcium (mg) *	Phosphate (mg)	Potassium (mg) *
Mature breast milk	**34**	**15**	**58**
Infant formula:			
Whey dominant	**45**	**24-39**	**85**
Casein dominant– "hungry baby"	**56**	**44**	**73**
Follow-on (whey dominant)	**66**	**40**	**75**
Cow's milk	**120**	**96**	**157**

Extended use of **infant formulas** (> 1 year)

Solids

"Cow's milk based foods such as yogurt, cheese, custard and rice pudding naturally contain high levels of **PHOSPHATE**. Discuss with your dietitian when would be a good time to start introducing these foods".

Phosphate binders

* Values considering a range of formula in the UK

NICE 2021

Phosphate Binder Medication

NICE National Institute for Health and Care Excellence

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Home › NICE Guidance › Conditions and diseases › Kidney conditions › Chronic kidney disease

Chronic kidney disease: assessment and management

NICE guideline | NG203 | Published: 25 August 2021 | Last updated: 24 November 2021

Phosphate binders for children and young people

1.11.9 Offer children and young people with CKD stage 4 or 5 and hyperphosphataemia a calcium-based phosphate binder to control serum phosphate levels. **[2021]**

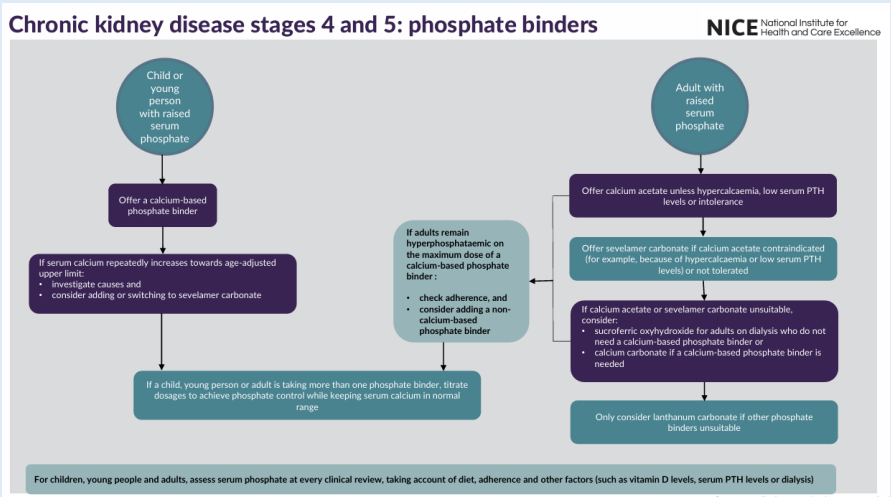
In August 2021, this was an off-label use of some calcium-based phosphate binders in people not on dialysis. See NICE's information on prescribing medicines.

1.11.10 If serum calcium increases towards, or above, the age-adjusted upper normal limit:

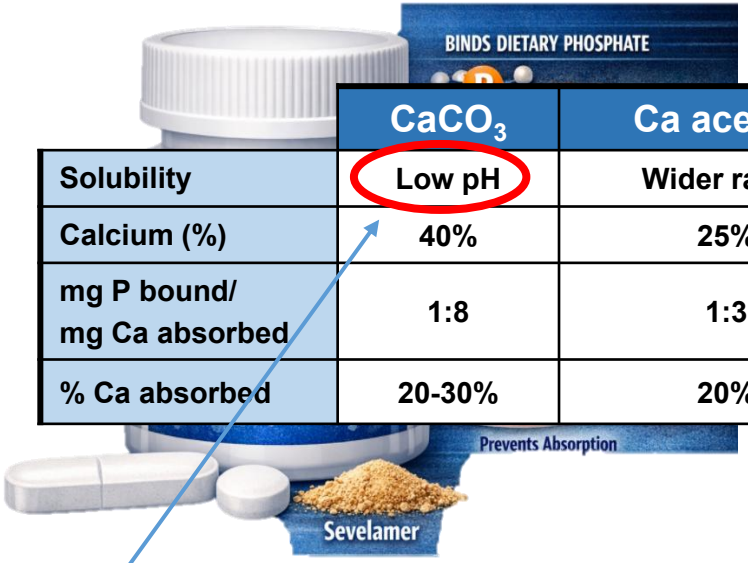
- investigate possible causes other than the phosphate binder
- consider reducing the dose of the calcium-based phosphate binder and adding sevelamer carbonate or switching to sevelamer carbonate alone. **[2021]**

In August 2021, this was an off-label use of sevelamer carbonate. See NICE's information on prescribing medicines.

1.11.11 For all children and young people who are taking more than 1 phosphate binder, titrate the dosage to achieve the best possible control of serum phosphate while keeping serum calcium levels below the upper normal limit. **[2021]**



PHOSPHATE BINDER MEDICATION



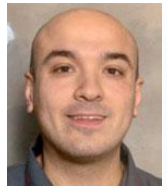
	$CaCO_3$	Ca acetate
Solubility	Low pH	Wider range
Calcium (%)	40%	25%
mg P bound/ mg Ca absorbed	1:8	1:3
% Ca absorbed	20-30%	20%

Better just before food
Less effective in Jejunum

£

Phosphate binder	Formulation	Cost per unit (NHS)
Calcium carbonate	500 mg chewable tablet	1 - 3 pence per tablet
Calcium acetate (Renacet®)	475 mg tablet	9 pence per tablet
Sevelamer carbonate	800 mg tablet	14 pence per tablet
Sevelamer carbonate	2.4 g sachet	~£2.80 per sachet

Calcium based	Non calcium based



*Fathallah-Shaykh, 2018
**Schiller, 1989
***McAlister, 2025

DIETARY ADHERENCE

KIREPORTS
KIReports.org

Barriers to and Facilitators of Phosphate Control in Children With CKD

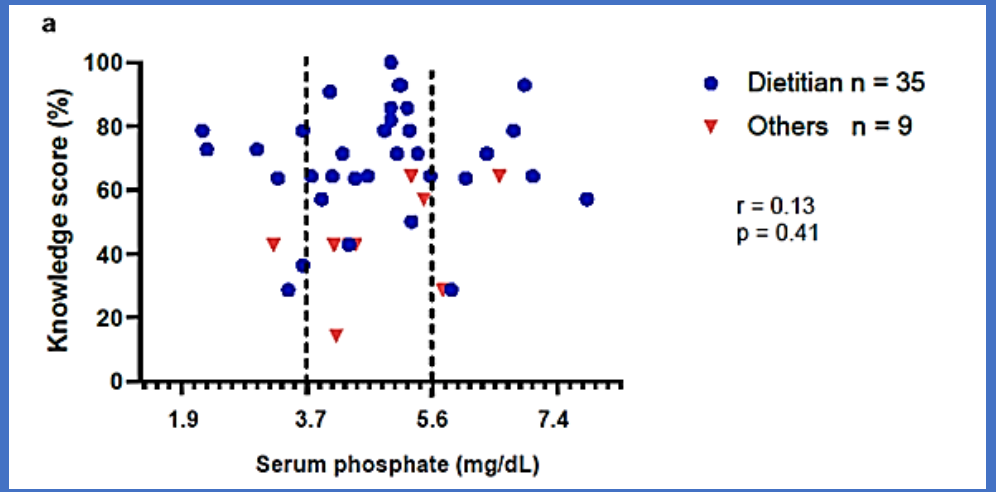
IMPACT STUDY

KIReports
McAlister, 2025

Sequential explanatory 2-phase prospective multicentre mixed method study

Phase 1	Phase 2
Questionnaires	Online Focus Groups

Phosphate (P) knowledge not linked to serum P levels



Phase 2

Online Focus Groups

3 overarching concepts

Navigating practical and informational support

Living with social and emotional disruption

Adapting to a lifelong journey

ractical advice and support are valued

"Rigid"	mother of 9-year-old boy
"Don't eat out"	mother of 14-year-old girl
"Bewildered"	father of 16-year-old girl
"Annoyed"	14-year-old girl
"Images too childish"	13-year-old girl

"Difficult to understand safe foods"	mother of 10-year-old boy
"Need something quick and easy to see"	mother of 16-year-old g
"Rely on dietitian to take lead"	mother of 13-year-old b
"Want relevant information"	mother of 16-year-old g
"Want trustworthy information"	16-year-old girl

Personalised strategies are preferred to facilitate

"Break it down"
"Set a timer on my phone"
"Constantly rattling"
13-yea

"It was a big thing to listen to what the doctors

The social environment of the child and family is disrupted

"Feel isolated"	mother of 13-year-old girl
"Don't eat when out with friends"	16-year-old boy
"Child eats separately to family"	father of 24-year-old girl
"Family moan that food is disgusting"	16-year-old boy
"Can't go to grandparents' house"	mother of 13-year-old

Education and self-management skills can influence

"Drives you nuts "
"Walking a tightrope"
"On autopilot,"
"Rules changed a few times"
"Not always positive experiences with medical team" n
"Now just get on with it"

The journey requires acceptance, adaptation and perseverance

Suggested strategies

More effective PHOSPHATE management

CONCLUSIONS

Management of hyperphosphataemia is essential to prevent **CKD-MBD**

Start **early** management of P intake – before serum P rises

Give practical support for **families for diet and phosphate binders**

Management together with **MDT**

<u>Regular reviews</u>

Check not limiting nutrition and growth

Q and A

Louise.mcalister@gosh.nhs.uk