PAEDIATRIC RENAL NUTRITION TASKFORCE

The dietary management of potassium in children with CKD stages 2-5 and on dialysis

A practical guide

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Foreword

The Pediatric Renal Nutrition Taskforce (PRNT) is an international team of pediatric renal dietitians and pediatric nephrologists, who develop clinical practice recommendations (CPRs) for the nutritional management of various aspects of kidney diseases in children.

In 2021, the taskforce published clinical practice recommendations regarding the dietary management of potassium (K^+) in children with CKD stages 2-5 and on dialysis, describing the common food sources of K^+, the assessment of K^+ intake, and the necessary adjustment of dietary K^+ intake to maintain serum K^+ levels within the normal range.

This booklet aims to provide a practical guide on how to implement these recommendations in every day clinical practice and should be read in conjunction with the published paper.*

*Desloovere A, Renken-Terhaerdt J, Tuokkola J et al. The dietary management of potassium in children with CKD stages 2-5D – clinical practice recommendations from the Pediatric Nutrition Taskforce. Pediatric Nephrology, 2021. doi.org/10.1007/s00467-021-04923-1

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

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Flow chart
summarising dietary management

Step 1: Dietary assessment

Identify the main dietary sources of K^+: foods, drinks, K^+ containing food additives, infant and enteral formulas, and nutritional supplements

Rapid assessment

A diet history of a typical 24-hour period, or food frequency questionnaire, focusing on K^+ rich foods and drinks

Detailed assessment

A 3-day prospective diet diary/food intake record

Step 2: Identify the non-dietary causes of dyskalemia

- Consider: pseudohyperkalemia, constipation, medications that affect serum K^+ (e.g. beta-blockers, oral K^+ supplements, K^+ containing medications, K^+ binding resins), dialysis, diuretics, diarrhea, renal tubular losses
- Correct these where possible

Step 3: Monitor and review

Normal range for serum K^+

- 3.5-5.0 mmol/L in infants, children and adolescents
- 3.5-5.5 mmol/L in neonates

- Only adjust dietary K^+ intake if the serum K^+ level is outside the normal range based on serial measurements

Flow chart
continued

Step 4: Dietary management of dyskalemia

Hyperkalemia

Neonate K^+ > 5.5 mmol/L
Infant K^+ > 5.0 mmol/L

1. INFANT FED BREASTMILK / INFANT FORMULA

Gradually replace some breastmilk/infant formula with a renal-specific low K^+ formula

- **Check serum K^+ If raised:**
- **Check serum K^+ If normal:** Maintain current diet

2.STARTING SOLID FOODS

Gradually replace breastmilk/infant formula with a mixed diet choosing lower K^+ foods with a high nutritional value

- **Check serum K^+ If raised:** Further replace some breastmilk/infant formula with renal-specific low K^+ formula OR Advise change in cooking methods
- **Check serum K^+ If normal:** Increase the amount of lower K^+ foods
  - **Check serum K^+ If normal:** Introduce higher K^+ high nutritional value foods

Child K^+ > 5.0 mmol/L

1. CHILD EATING FOOD

Limit high K^+ foods with low nutritional value favoring fresh non-processed foods

- **Check serum K^+ If raised:** Educate the family on replacement of high K^+ foods with alternative lower K^+ foods with similar nutritional value
  - **Check serum K^+ If raised:** Educate on food labels and check for K^+ additives
    - **Check serum K^+ If raised:** Advise change in cooking methods
- **Check serum K^+ If normal:** Maintain current diet

2. CHILD TUBE FED

Gradually replace some enteral tube formula with a renal-specific low K^+ formula

- **Check serum K^+ If raised:**
- **Check serum K^+ If normal:** Maintain current formula composition

Hypokalemia

Serum K^+ < 3.5 mmol/L

Infant receiving some renal-specific low K^+ formula

- Gradually replace with breastmilk or whey-dominant infant formula

Infant and child

- Gradually increase K^+ intake by using high K^+ foods and drinks with high nutritional value, or formulas, where appropriate

Step 5: Advice on use of K^+ binder medication

Support the management of K^+ binder medication to optimize efficacy and to avoid side effects

Step 1: Dietary assessment

Identify the main sources of K^+. Dietary K^+ assessment is only required for those with dyskalemia. Consider contributions from dialysate and medications in addition to K^+ from food, drinks, food additives and nutritional supplements.

Practical points

- If a child's dietary intake is exclusively from infant or enteral formulas, K^+ intake can be quantitatively accurately assessed. An intake of 1-3 mmol/kg/day for infants and young children is considered a low K^+ intake.
- If the child is eating a normal diet, it is impossible to calculate K^+ intake accurately due to differences in bioavailability of K^+ from foods and a lack of information regarding K^+ containing additives in processed packaged foods.
- In most instances, it is sufficient to identify the main sources of K^+ in the diet. (Table 1).
- Breastmilk has a lower K^+ content than whey-dominant infant formula.
- Whole, semi-skimmed and skimmed milks all have the same K^+ content.

Table 1: Main dietary sources of K^+

Infants	Children 18 months – 18 years
High nutritional value	
Breastmilk Infant formula Fruit Meat Nuts Potatoes Pulses Vegetables	Cereals (grains) and cereal products Dried fruit Fruit and fruit products Meat Milk and milk products Nuts Potatoes and other starchy roots and tubers Pulses Vegetables
Low nutritional value	
Fruit juices	Canned vegetable soup Chocolate Coffee Custards Fruit juices Ice creams Potato crisps (chips) Vegetable juices

Additives and E-numbers containing potassium

K^+ additives may be used in manufactured foods as e.g. a preservative, sweetener, emulsifier, stabiliser, thickener or gelling agent. Their use can more than double the K^+ content of a food. The bioavailability of K^+ containing additives is 90–100%. It is not mandatory in all countries for manufacturers to declare K^+ content in the nutritional information/ingredients list on food packaging.

Look for "potassium" as a part of an ingredient name in the ingredients list of processed foods. This indicates the presence of K^+ additives. Table 2 shows EU approved additives and their E numbers which may be found on an ingredient label.

Table 2: K^+ additives

Preservatives		Others*	
E202	Potassium sorbate	E261	Potassium acetate
E212	Potassium benzoate	E326	Potassium lactate
E224	Potassium metabisulphite	E332	Potassium citrates
E228	Potassium hydrogen sulphite	E336	Potassium tartrates
E249	Potassium nitrite	E337	Sodium potassium tartrate
E252	Potassium nitrate	E340	Potassium phosphates
E283	Potassium propionate	E351	Potassium malate
Sweeteners		E357	Potassium adipate
E950	Acesulfame K	E501	Potassium carbonates
E954	Saccharin and its Na, K and Ca salts	E508	Potassium chloride
Emulsifiers, stabilisers, thickeners and gelling agents		E515	Potassium sulphates
E402	Potassium alginate	E522	Aluminium potassium sulphate
E470a	Sodium, potassium and calcium salts of fatty acids	E525	Potassium hydroxide
		E536	Potassium ferrocyanide
		E555	Potassium aluminium silicate
		E577	Potassium gluconate
		E622	Monopotassium glutamate
		E628	Dipotassium guanylate
		E632	Dipotassium inosinate

*Acid, acidity regulators, anti-caking agents, anti-foaming agents, bulking agents, carriers and carrier solvents, emulsifying salts, firming agents, flavour enhancers, flour treatment agents, foaming agents, glazing agents, humectants, modified starches, packaging gases, propellants, raising agents and sequestrants.

Table 3: Foods which may contain K^+ additives

Their presence may be brand-related.

Meat and fish	Processed meat, fish, cooked shellfish
Baked items	Bread, wheat flour, cookies, pastries
Dairy	Milk and milk products: puddings, ice creams, desserts, cheeses
Potato products	Gnocchi, potato crisps (chips)
Vegetables	Cooked red beets, olives, canned vegetables
Fruit	Dried fruit, fruit juice, grapes (juice), canned fruit, cake filling
Herbs and spices	Sauces, cinnamon, mustard, dried herbs, salt, salt substitutes
Confectionery items	Sugar, jam, sweets, chocolate
Drinks	Soft drinks, mineral water, coffee creamer, instant coffee
Fast foods	Burgers, chicken nuggets, sausage roll, pancakes, maize-based snacks
Miscellaneous	Food supplements/multivitamins, oils, fats, sweeteners (acesulfame K, saccharin)

Use the table below to document common food sources of K^+ in your country (see Tables 10, 11, 12)

Food	Portion size	K^+ (mg per portion)

Step 2: Identify non-dietary causes of dyskalemia

Correct non-dietary causes of dyskalemia (Tables 4 and 6) before adjusting the dietary K^+ intake.

Table 4: Non-dietary causes of hyperkalemia

Non-dietary causes hyperkalemia
Pseudohyperkalemia
Impaired renal excretion · Low GFR · Medications: · K^+-sparing diuretics (spironolactone, triamterene, amiloride) · RAASi* (ACE* inhibitors, ARBs*, direct renin inhibitors) · Others (e.g. calcineurin inhibitors, NSAIDs*, trimethoprim) · Chronic metabolic acidosis · Tubular disorders · Low aldosterone (e.g. Gordon syndrome) · Aldosterone resistance (e.g. pseudohypoaldosteronism)
Constipation
Impaired cellular entry of K^+ (beta-blockers)
Exogenous K^+ administration · Oral K^+ supplements · K^+ containing medications (e.g. Penicillin V potassium)

*RAASi, renin-angiotensin-aldosterone system inhibitors; ACE, angiotensin converting enzyme; ARBs, angiotensin receptor blockers; NSAIDs, nonsteroidal anti-inflammatory drugs.

These medications may contribute to **hyperkalemia**.

Table 5: Commonly used medications that may contain K^+

Drug	Formulation*	K^+ (mg) per stated dose (5ml/powder/ tablet/sachet)	K^+ (mmol) per stated dose (5ml/powder/ tablet/sachet)
Co-amoxiclav®	125/31.25 mg/5mL oral suspension	5.95	0.15
Co-amoxiclav®	250/62.5 mg/5mL oral suspension	11.9	0.31
CoasmolCol®	6.9g powder for oral solution	11.7	0.30
CoasmolCol® **	13.1g powder for oral solution	23.4	0.60

Table 5: Continued

Drug	Formulation*	K^+ (mg) per stated dose (5ml/powder/ tablet/sachet)	K^+ (mmol) per stated dose (5ml/powder/ tablet/sachet)
Losartan®	12.5mg tablets	1.06	0.03
Losartan®	25mg tablets	2.12	0.05
Losartan®	50mg tablets	4.24	0.11
Losartan®	100mg tablets	8.48	0.22
Dioralyte®	Sachet	157.9	4.05
Sandoz oral rehydration solution®	Sachet	157.1	4.02
Gaviscon®	Oral suspension (per 5ml)	39	1.00
Phenoxymethyl Penicillin®	125mg/5ml oral solution	12.5	0.32
Phenoxymethyl Penicillin®	250mg/5ml oral solution	25	0.64

Source: manufacturers' data
* K^+ content may vary depending on different formulations/manufacturers
** Available as Movicol® 13.7g sachet with an equivalent K^+ content

Table 6: Non-dietary causes of hypokalemia

Non-dietary causes of hypokalemia
Dialysate K^+ losses
Medications · K^+ binding resins (e.g. sodium polystyrene sulfonate) · Diuretics (loop or thiazide)
Gastrointestinal K^+ losses · Vomiting or drainage from gastrostomy tubes · Diarrhea · Laxative or enema abuse
Renal tubular disorders (e.g. cystinosis, Bartter syndrome)
Metabolic alkalosis

Step 3: Monitor and review

Adjust K^+ intake to maintain serum K^+ levels within the normal range based on serial measurements.

Normal range for serum K^+ is 3.5-5.0 mmol/L for infants, children and adolescents or 3.5-5.5 mmol/L for neonates.

Review points: possible causes of hyperkalemia
serum K^+ > 5.0 mmol/L or > 5.5 mmol/L for neonates

- Medications containing K^+
- Non-dietary causes (Table 4)
- Excessive intake of:
  - processed foods with K^+ containing additives
  - food products with salt substituted with KCl
  - fast foods
  - K^+ rich food of low nutritional value
  - K^+ rich fresh foods

Review points: possible causes of hypokalemia
serum K^+ < 3.5 mmol/L

- Dietary prescription contains too high a proportion of renal-specific low K^+ formula
- Restricted K^+ diet is too rigid
- Non-dietary causes (Table 6)

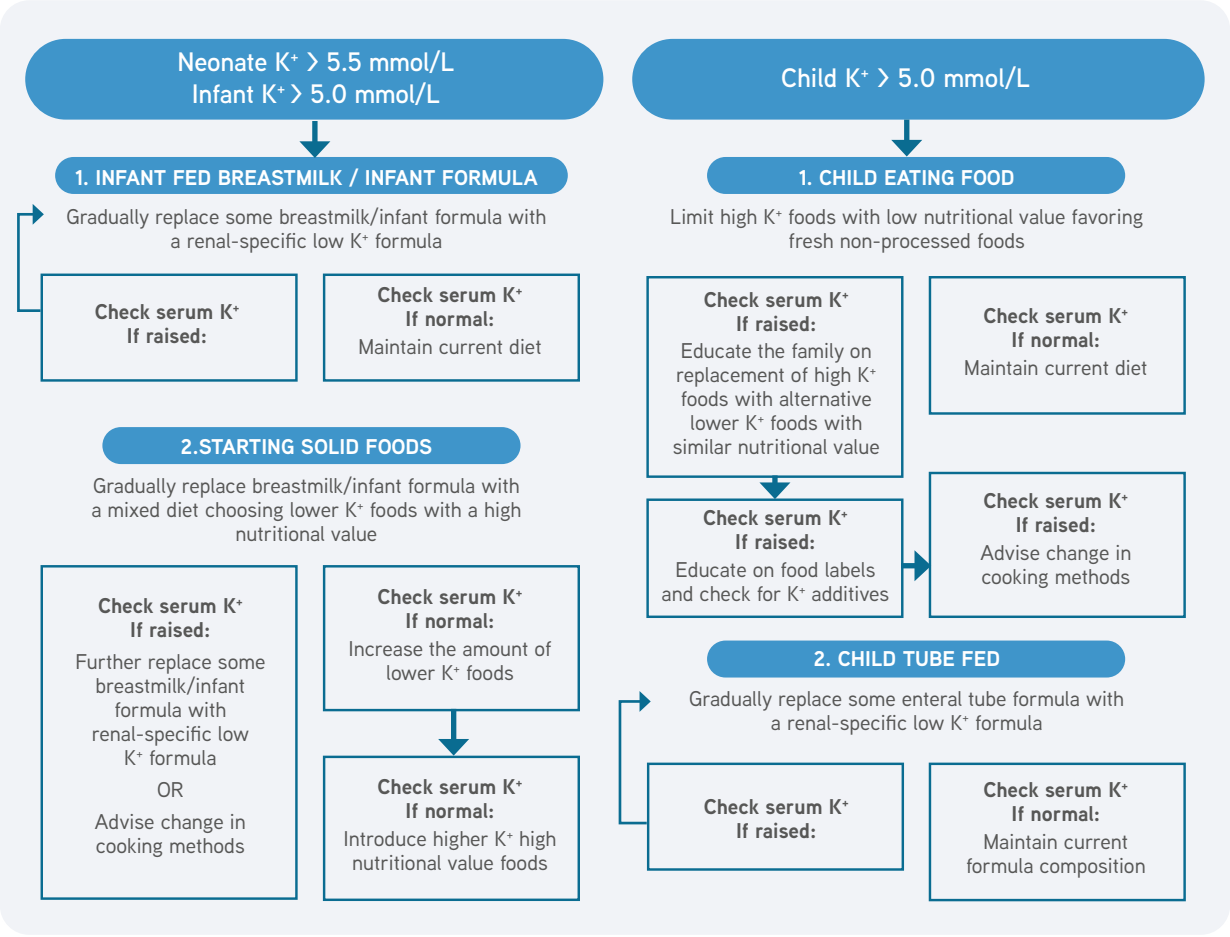
Step 4: Dietary management of dyskalemia

Aim for K^+ intake in CKD

- To maintain serum K^+ within normal range 3.5-5.0 mmol/L or 3.5-5.5 mmol/L for neonates.
- Make dietary adjustments according to trends in serum K^+ levels, not on single value.

Hyperkalemia

- Severe, life-threatening hyperkalemia requires rapid medical intervention and discontinuation of all sources of K^+ including medications, parenteral fluids and diet.
- In a child with persistent or recurrent episodes of hyperkalemia, decrease the intake of K^+ without compromising nutrition.
- Calculation of K^+ intake: only when a child's dietary intake is exclusively from infant or enteral formulas can K^+ intake be quantitatively assessed with any accuracy. When dietary K^+ restriction is required, 1–3 mmol K^+/kg/day is a reasonable place to start.



Before manipulating the dietary K^+ content, ensure there is sufficient energy intake. Deficient energy intake may manifest as hyperkalemia due to catabolism as K^+ is released due to tissue breakdown.

Breastfeeding/infant formula/enteral tube feeding/renal-specific formulas

Infant feeding:

- Breastfeeding/breastmilk is low in K^+ and is the preferred source of nutrition. If the K^+ content of breastmilk causes hyperkalemia, reduce K^+ intake by substituting some of the breastmilk with a renal-specific low K^+ infant formula. Be aware that Ca and P intakes may be reduced, and Na intake increased, when introducing renal-specific formula.
- If the K^+ content of standard infant formula causes hyperkalemia reduce the K^+ intake stepwise by combining standard formula with a renal-specific low K^+ formula. Be aware that Ca and P intakes may be reduced, and Na intake increased, when introducing renal-specific formula.
- If a renal-specific low K^+ formula is not available dilute standard infant formula to reduce K^+ content. **Use great caution:** energy and protein modules **must** be added to the diluted formula, together with a suitable vitamin and mineral preparation, to restore the nutritional profile (Table 7).
- Alternatively add a K^+ binding resin to expressed breastmilk (EBM) or standard infant formula, then decant the EBM/formula (Table 8). Close monitoring of serum electrolytes and micronutrients is warranted due to alterations as a consequence of adding the K^+ binder.
- Do not use plant-based milks such as almond, oat and soya milks as a sole source of nutrition. They are not fully supplemented with vitamins and minerals and may have a low energy and protein content. Additionally, it is not advisable to give rice milk to infants or young children due to its high arsenic content.

Important note: Encourage and support the breastfeeding mother to maintain lactation by expressing her milk while her infant is bottle feeding. This will ensure that breastmilk production isn't impacted while there is a need for a low K^+ formula. The infant can resume (partly) breastfeeding once the serum K^+ has normalized.

Table 7: Example of a diluted standard infant formula to lower K^+ intake in an infant

Typical whey-dominant infant formula mixed as instructed by the manufacturer, 3 scoops (13 g) formula powder added to 90 ml water to make 100 ml formula:

	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Na (mg)	K (mg)	Ca (mg)	PO4 (mg)
3 scoops infant formula powder (13 g)	68	1.3	7.2	3.6	18	69	51	24

Diluted formula (33% less K^+) with added energy and protein modules to preserve energy and protein density:

	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Na (mg)	K (mg)	Ca (mg)	PO4 (mg)
2 scoops infant formula powder (9 g)	47	0.9	5.0	2.5	12	47	35	17
0.5 g protein powder	2	0.5	0	0	0*	0*	0*	0*
2.5 ml fat emulsion	11	0	0	1.3	0	0	7	0
2 g glucose polymer	8	0	2.0	0	0	0	0	0
+ water up to 100 ml								
per 100 ml	68	1.4	7.0	3.8	12	47	42	17

*values vary according to brand of protein powder

Vitamin-mineral supplements (without vitamin A) may be necessary to achieve nutritional adequacy. A phosphate supplement may also be required.

Compare with a renal-specific low K^+ formula mixed as instructed by the manufacturer, 1 scoop (7 g) added to 30 ml water, standard 20% dilution:

	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Na (mg)	K (mg)	Ca (mg)	PO4 (mg)
per 100 ml (20% dilution)	100	1.5	12.6	4.8	48	22	24	19

Table 8: Pretreatment of liquids to reduce the K^+ content

1. Add sodium polystyrene sulfonate (SPS) to the bottle of standard infant formula or EBM.
2. Allow to stand and precipitate for 30 minutes in a refrigerator.
3. Carefully decant off the treated formula/EBM, leaving the residue that has settled out in the bottom of the bottle.
4. Discard the residue.

- The dose of SPS should be titrated according to individual tolerance and serum K^+ levels.
- A starting dose of 0.4-1.5 g/100 ml or 0.25-1.0 g/mmol (mEq) K^+ is suggested.

Enteral tube feeding:

- For children receiving an enteral tube feed, reduce K^+ intake stepwise by combining the enteral formula with a renal-specific low K^+ formula.
- If a renal-specific low K^+ formula is not available:
  - dilute the enteral formula to the desired K^+ profile. Add energy and protein modules to the diluted formula, together with a suitable vitamin and mineral preparation, to restore the nutrient profile (Table 9).
  - or add a K^+ binding resin, then decant the formula (Table 8). Monitor serum electrolytes and micronutrients that may be altered by the K^+ binder.

Table 9: Example of a diluted pediatric enteral formula to lower K^+ intake in a child

Typical pediatric enteral formula (ready to use):

	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Na (mg)	K (mg)	Ca (mg)	PO4 (mg)
100 ml pediatric enteral formula	101	2.7	12.3	4.4	60	110	60	50

Diluted pediatric enteral formula (20% less K^+) with added energy and protein modules to preserve energy and protein density:

	Energy (kcal)	Protein (g)	CHO (g)	Fat (g)	Na (mg)	K (mg)	Ca (mg)	PO4 (mg)
80 ml pediatric enteral formula	81	2.2	9.8	3.5	48	88	48	40
0.5 g protein powder	2	0.5	0	0	0*	0*	0*	0*
2.5 ml fat emulsion	11	0	0	1.3	0	0	7	0
2 g glucose polymer	8	0	1.9	0	0	0	0	0
+ water up to 100 ml								
per 100 ml	102	2.6	11.7	4.8	48	88	55	40

*values vary according to brand of protein powder

Vitamin-mineral supplements (without vitamin A) may be necessary to achieve nutritional adequacy. A phosphate supplement may also be required.

For composition of a renal-specific low K^+ formula, see Table 7.

Renal-specific formulas:

- The use of renal-specific formulas as the sole source of nutrition should be short term (hours rather than days). The low K^+ content may cause a rapid fall in serum K^+.
- Renal-specific formulas may be used as the sole source of nutrition for the initial treatment of moderate to severe hyperkalemia, with careful monitoring of the serum K^+ levels.
- Introduce breastmilk/standard infant formula/enteral tube formula in a stepwise manner as soon as serum K^+ levels allow.
- Renal-specific formulas may also be used for daytime drinks/feeds or overnight tube feeding to allow a more liberal intake of K^+ in the diet.
- For composition of a renal-specific low K^+ formula, see Table 7.

Food

Starting solid foods

Introduce solid foods with progression to varied textures and content according to the infant's cues and oral motor skills, as recommended for healthy infants.

Start by gradually replacing breastmilk or standard infant formula with fruits and vegetables with low (<39 mg per portion) or moderate (39-117 mg per portion) K^+ content (Tables 10, 11).

Check the K^+ content of any commercial complementary foods that may be used.

CHECK SERUM K^+

- If K^+ is **normal** increase the amount of fruits and vegetables with low or moderate K^+ content and introduce some higher K^+ fruits and vegetables.
- If K^+ is **raised** continue stepwise replacement of some of the standard infant formula or breastmilk with renal-specific low K^+ formula to allow a greater variety of K^+-containing fruits and vegetables, or advise in change of cooking methods to reduce K^+ content of foods.

CHECK SERUM K^+

- If K^+ is **normal** introduce high K^+ high nutritional value foods.

- The routine omission of vegetables from the diet based simply on their K^+ content should be discouraged, considering the bioavailability of K^+ in unprocessed plant foods is no more than 60% and they offer other nutritional benefits (vitamins, minerals, fiber).
- It may be beneficial to choose foods with a low K^+-fiber ratio to enable a higher fiber intake to be maintained while lowering dietary K^+.

Children (> 1 year) eating food

Limit the intake of high K^+ foods and drinks with low nutritional value such as potato crisps (chips), chocolate, custards, ice creams, coffee, vegetable juices and fruit juices.

CHECK SERUM K^+

- If K^+ is **normal** maintain current diet.
- If K^+ is **raised** educate and encourage replacement of high K^+ foods with alternative lower K^+ foods with similar nutritional value (Table 12).

CHECK SERUM K^+

- If K^+ is **normal** maintain current diet.
- If K+ is **raised** educate and encourage about *reading packaging labels*; check all manufactured foods for *K^+ additives* (Table 2). Manufacturers are not required in all countries to list K^+ content on the ingredients/nutrients lists. In general ready to eat, processed and 'fast food' contains more K^+ than fresh food. Recommend choosing fresh, unprocessed foods as much as possible.
- Salt substitutes may be high in K^+ and should not be used.

CHECK SERUM K^+

- If K^+ is **raised** advise to change *cooking methods* to decrease K^+ content of foods:
  - cutting potatoes and other tuberous roots and legumes very finely before cooking; shredding potatoes reduces K^+ content more than dicing potatoes
  - cooking potatoes and other tuberous roots and legumes in ample water reduces their K^+ content by 35-80%
  - double cooking reduces K^+ more than cooking once; bringing the water to the boil and replacing the water with fresh water and boiling again is recommended to reduce the K^+ content
  - caution: cooking with these methods reduces the content of other minerals and water-soluble vitamins
  - compared with boiling, sous-vide cooking (low temperature cooking under vacuum) increases the K^+ content of foods; frying also increases K^+ content; while microwave cooking reduces K^+ content, it is to a lesser extent than boiling; food may be reheated in a microwave oven
  - don't use the cooking fluid from vegetables for the preparation of gravies or sauces as it has as high K^+ content

Table 10: K^+ content of vegetables and pulses*

High potassium (>117mg (3mmol) per portion) | Moderate potassium (39-117mg (1-3mmol) per portion) | Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)
VEGETABLES AND PULSES (LEGUMES)		
Asparagus, steamed	75g (3 spears)	213
Aubergine, fried in oil, including skin	65g (¼ medium)	111
Baked beans, canned in tomato sauce	80g (2 Tbsp)	218
Beansprouts	20g (1 Tbsp)	15
Beetroot, boiled	35g (1 small)	106
Black eye beans, dried, boiled	40g (1 Tbsp)	128
Broad beans, boiled	60g (1 Tbsp)	248
Broccoli, boiled	40g (1 Tbsp)	85
Brussels sprouts, boiled	40g (1 Tbsp)	161
Butter beans, dried, boiled	35g (1 Tbsp)	156
Butternut squash, baked	40g (1 Tbsp)	97
Cabbage, green, boiled	40g (1 Tbsp)	75
Cannellini beans, canned, reheated	30g (1Tbsp)	90
Carrot, boiled	40g (1 Tbsp)	66
Cauliflower, boiled	40g (1 Tbsp)	86
Celery	12g (½ stick)	36
Chickpeas, dried, boiled	40g (1 Tbsp)	112
Courgette, boiled	40g (1 Tbsp)	95
Cucumber	40g (6 slices)	62
Gherkins	35g (1)	37
Houmous	30g (1 Tbsp)	57
Leek, boiled	40g (1 Tbsp)	68
Lentils, red, split, dried, boiled	40g (1 Tbsp)	88
Lettuce, average	20g (2 leaves)	44
Mushrooms, fried in oil	40g (4 medium)	217
Okra, boiled	30g (6 medium)	160
Onion, fried in oil	25g (1 Tbsp)	47
Onion, raw	60g (1 small)	83
Parsnip, boiled	40g (1 Tbsp)	128
Peas, boiled	30g (1 Tbsp)	69
Peppers, green, raw, sliced	30g (3 rings)	36
Peppers, red, yellow, raw, sliced	30g (3 rings)	62
Plantain, boiled	50g (¼ medium)	200
Pumpkin, boiled	40g (1 Tbsp)	34
Radishes	20g (2)	40
Red kidney beans, canned, reheated	30g (1Tbsp)	110
Runner beans, boiled	30g (1 Tbsp)	31
Spinach, boiled	40g (1 Tbsp)	64
Swede, boiled	40g (1 Tbsp)	70
Sweetcorn, kernels canned in water, drained	30g (1 Tbsp)	47
Sweet potato, boiled	40g (1 Tbsp)	150
Tomato	65g (1 small)	145
Tomato, cherry	15g (1)	41
Tomato, canned	100g (¼ can)	212
Turnip, boiled	40g (1 Tbsp)	80
Turnip tops, boiled	50g (1 Tbsp)	37
Watercress	15g (1 Tbsp)	45
Yam, boiled	60g (1 small egg-sized)	162

* Where available, refer to country specific composition tables. Compositional data sourced and adapted from Public Health England: McCance and Widdowson's The Composition of Foods Integrated Dataset 2019.

Tbsp, rounded tablespoon; tsp, rounded teaspoon.

Table 11: K^+ content of fruit*

High potassium (>117mg (3mmol) per portion) | Moderate potassium (39-117mg (1-3mmol) per portion) | Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)
FRUIT (edible weight, medium size and fresh unless stated otherwise)		
Apple	100g (1)	100
Apricot, semi-dried	20g (3)	276
Apricot	80g (2)	216
Avocado	75g (½)	338
Banana	80g (1 small)	264
Blackberries	40g (8)	64
Blueberries	45g (2 Tbsp)	36
Cherries	40g (10)	84
Clementine	50g (1 small)	64
Dates, dried	30g (2)	218
Fig, semi-dried	40g (2)	356
Fruit cocktail, canned in juice/syrup	30g (1 Tbsp)	32
Grapefruit	80g (½)	160
Grapes	60g (12)	130
Kiwi fruit	60g (1)	174
Lychees, raw, flesh only	20g (2)	32
Mandarin	50g (1 small)	64
Mandarins, canned in syrup	50g (2 Tbsp)	42
Mango	75g (½)	135
Melon, honeydew	200g (1 slice)	360
Nectarine	90g (1)	153
Olives, no stones	30g (10)	27
Orange	120g (1 small)	146
Passion fruit	30g (2)	60
Peach	110g (1)	176
Pear	100g (1)	105
Pineapple	80g (1 large slice)	97
Pineapple, canned in juice/syrup	45g (2 slices)	35
Plum	55g (1)	132
Prunes, semi-dried	30g (4)	220
Raisins/sultanas, dried	30g (1 Tbsp)	312
Raspberries	60g (15)	102
Satsuma	50g (1 small)	64
Strawberries	80g (7)	136
Tangerine	50g (1 small)	64
Watermelon	120g (10 balls)	120

*Where available, refer to country specific composition tables. Compositional data sourced and adapted from Public Health England: McCance and Widdowson's The Composition of Foods Integrated Dataset 2019.

Tbsp, rounded tablespoon; tsp, rounded teaspoon.

Table 12: High K^+ foods with alternative lower K^+ foods*

High potassium (>117mg (3mmol) per portion) | Moderate potassium (39-117mg (1-3mmol) per portion) | Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)	Potassium (mg per 100g)
MILKS AND DAIRY PRODUCTS			
Almond drink#†	100ml	67	67
Rice drink#†	100ml	27	27
Soya milk, unsweetened†	100ml	74	74
Human breastmilk, mature^	100ml	58	58
Standard whey-dominant infant formula	100ml	70	70
Fromage frais, fruit flavor	60g (1 small pot)	86	143
Ice cream, vanilla, soft scoop**	60g (1 scoop)	98	163
Cow's milk, whole	100ml	157	157
Custard, canned**	100g (3 Tbsp)	129	129
Yogurt, whole milk, fruit	125g (1 small pot)	213	170
POTATOES			
Potatoes, new, boiled, with skin	60g (1 small egg-sized)	226	377
Potatoes, old, baked in jacket, flesh only, no skin	100g (1 small)	360	360
Potatoes, chips, cut fine, fast food**	75g (small portion)	408	544
Potatoes, old, mashed with butter	45g (1 Tbsp)	151	337
Potatoes, old, roast	60g (1 small egg-sized)	358	597
CEREAL (GRAIN) AND CEREAL PRODUCTS			
Bread, white	40g (1 thick slice)	54	134
Bread, brown	40g (1 thick slice)	86	216
Bread, whole meal^^	40g (1 thick slice)	101	253
Breakfast cereal, cornflakes, fortified	20g (3 Tbsp)	18	88
Breakfast cereal, Swiss style muesli or crunchy/crispy style muesli, with nuts, unfortified	30g (2 Tbsp)	87	290
Breakfast cereal, porridge made with water, fortified	135g (3 Tbsp)	62	46
Breakfast cereal, porridge made with whole milk, fortified	135g (3 Tbsp)	268	199
Breakfast cereal, puffed wheat, honey coated, fortified	20g (3 Tbsp)	38	188
Breakfast cereal, wheat biscuits, fortified	20g (1 biscuit)	79	397
Breakfast cereal with chocolate	30g (2 Tbsp)	74	245
Breakfast cereal, wheat and multigrain, chocolate flavored, fortified	30g (2 Tbsp)	107	355

Table 12: High K^+ foods with alternative lower K^+ foods* (continued)

High potassium (>117mg (3mmol) per portion)

Moderate potassium (39-117mg (1-3mmol) per portion)

Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)	Potassium (mg per 100g)
CEREAL (GRAIN) AND CEREAL PRODUCTS			
Cake, sponge, jam and butter cream	60g (1 slice)	79	132
Cake, sponge, chocolate fudge	60g (1 slice)	214	357
Cake, sponge, fruit, plain**	60g (1 slice)	231	385
Cookie (biscuit), digestive, half coated with chocolate**	17g (1)	44	258
Cookie (biscuit), semi-sweet**	14g (2)	24	168
Cookie (biscuit), short, sweet**	20g (2)	31	155
Cream crackers	10g (1)	21	215
Crispbread	10g (1)	51	511
Noodles, egg, fine, boiled	160g (1 cup)	91	57
Pasta, white, dried, boiled	90g (3 Tbsp)	103	114
Polenta, raw	10g (1 Tbsp)	3	3
Rice, white boiled	80g (2 Tbsp)	10	12
Rice, brown, boiled^^	80g (2 Tbsp)	50	62
Risotto, plain	40g (1 Tbsp)	29	73
Semolina, raw	15g (1½ Tbsp)	32	214
Tapioca, raw	15g (1½ Tbsp)	3	2
NUTS AND SEEDS			
Almonds	13g (6 whole)	95	733
Brazil nuts	10g (3 whole)	66	660
Cashews/hazel nuts	10g (10 whole)	72	720
Peanuts, unsalted	13g (10 whole)	87	670
Peanut butter, smooth	15g (thinly spread on 1 slice of bread)	105	700
Walnuts	20g (6 halves)	90	450
Pumpkin seeds	20g (1 Tbsp)	164	820
Sunflower seeds	16g (1 Tbsp)	114	710
Sesame seeds	8g (1 Tbsp)	46	570
Chia seeds dried#	6g (1 Tbsp)	49	813
Hemp seeds#	7g (1 Tbsp)	84	1200
Poppy seeds	7g (1 Tbsp)	49	700
Pine nuts	15g (1 Tbsp)	117	780
Tahini paste	19g (1 tsp)	110	580

Table 12: High K⁺ foods with alternative lower K⁺ foods* (continued)

High potassium (>117mg (3mmol) per portion) | Moderate potassium (39-117mg (1-3mmol) per portion) | Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)	Potassium (mg per 100g)
MEAT, CHICKEN, FISH			
Burger, beef, commercial, grilled, average**	35g (1 patty)	133	380
Chicken/lamb/beef/pork, roasted, meat only	50g (1 thick slice)	165/180/185/200	330/360/370/400
Chicken nuggets**	70g (4)	195	278
Cod, steamed/microwaved, flesh only	60g (½ medium fillet)	254	424
Cod in batter, baked	60g (½ small fillet)	138	230
Salmon, baked/grilled, flesh only	50g (½ medium fillet)	206	412
MISCELLANEOUS			
Candy (boiled sweets)	5g (1 piece)	0	5
Potato crisps**	25g (1 small bag)	332	1328
Tortilla chips**	25g (1 small bag)	71	285
Corn snacks**	25g (1 small bag)	82	329
Twiglets**	25g (1 small bag)	115	460
Chocolate, plain**	50g (1 small bar)	150	300
Chocolate, milk**	50g (1 small bar)	226	451
Coffee, instant, powder**	2g (1 tsp)	76	3780
Drinking chocolate, powder**	6g (1tsp)	30	495
Cocoa, powder**	6g (1tsp)	90	1500
Yeast extract	1g (thin scraping on 1 slice of bread)	21	2100
Margarine	5g (1 tsp)	trace	trace
Butter	5g (1 tsp)	1	27
Oil (except sesame oil)	10g (1 Tbsp)	0	trace
Oil, sesame	10g (1 Tbsp)	2	20
Jam/marmalade	15g (1 Tbsp)	6	43
Honey	15g (1 Tbsp)	7	51
Sugar	5g (1 tsp)	0	5
Vinegar	15g (1Tbsp)	5	34
Herbs with low K⁺ content Δ	1g (1 tsp)	3-<39	255-<3900
Herbs with moderate K⁺ content ΔΔ	1g (1 tsp)	39-47	3900-4700
Spices with low K⁺ content ΔΔΔ	2g (1 tsp)	1-< 39	73-<1950
Spices with moderate K⁺ content ΔΔΔΔ	2g (1 tsp)	39-58	1950-2910
White sauces	15g (1 Tbsp)	25-28	167-188
Tomato-based sauces	15g (1 Tbsp)	42	280
Molasses	15g (1 Tbsp)	220	1460
Salt substitutes	1g (1 tsp)	360–500	36,000-50,000

Table 12: High K⁺ foods with alternative lower K⁺ foods* (continued)

High potassium (>117mg (3mmol) per portion) | Moderate potassium (39-117mg (1-3mmol) per portion) | Lower potassium (<39mg (1mmol) per portion)

Food	Portion size	Potassium (mg per portion)	Potassium (mg per 100g)
DRINKS			
Water, fizzy drinks, fruit cordials	150ml (1 glass)	0	0
Apple juice	150ml (1 glass)	133	89
Orange juice	150ml (1 glass)	164	164
Carrot juice	150ml (1 glass)	360	240
Tomato juice	150ml (1 glass)	345	230
Tea, black, green, herbal	100ml (1 cup)	24	24

Compositional data sourced and adapted from Public Health England; McCance and Widdowson's The Composition of Foods Integrated Dataset 2019. Exception #: U.S. Department of Agriculture, Agricultural Research Service. FoodData Central, 2019. **https://fdc.nal.usda.gov/**

Tbsp, rounded tablespoon; tsp, rounded teaspoon.

* Where available, refer to country specific composition tables. ** low nutritional value.

^ McCance and Widdowson 2019; Analyses is based on data published in 1977. More recent local analysis of breastmilk may have a different potassium content. ^^ The routine omission of products from the diet based simply on their K content should be discouraged, considering the bioavailability of K in unprocessed plant foods is no more than 60% and they offer other nutritional benefits (vitamins, minerals, fiber). It may be beneficial to choose foods with a low K-fiber ratio to enable a higher fiber intake to be maintained while lowering dietary K.

†Plant-based drinks and milks are not suitable as a sole source of nutrition. It is not advisable to give rice milk to infants and young children due to its high arsenic content.

Δ Basil (dried, ground; fresh), coriander leaves (fresh), coriander seeds, dill (dried; fresh), dill seeds, marjoram (dried), mint (dried; fresh), oregano (dried, ground; fresh), parsley (fresh), rosemary (fresh; dried), sage (dried, ground; fresh), tarragon (dried, ground), thyme (dried, ground; fresh) ΔΔ Chervil (dried), coriander leaves (dried), parsley (dried) ΔΔΔ Cardamom (ground), cinnamon (ground), cloves (dried), cumin seeds, curry powder, fennel seeds, ginger (fresh; ground), nutmeg (ground), pepper (black; white), saffron ΔΔΔΔ Chilli powder, paprika, pepper cayenne (ground), turmeric (ground).

Hypokalemia

- Infant and child: increase the K⁺ content of the diet gradually by using high K⁺ foods and drinks with high nutritional value, or formulas, where appropriate.
- When an infant is receiving some renal-specific low K⁺ formula, gradually replace it with breastmilk or whey-dominant infant formula in a stepwise manner.
- Severe, life-threatening hypokalemia requires prompt medical intervention, usually requiring intravenous K⁺ infusion.

Step 5: Advice on use of potassium binder medication

Support the management of K⁺ binder medication to optimize efficacy and to avoid side effects.

- Daily use of an oral K⁺ binder to control serum K⁺ level may be considered when hyperkalemia cannot be corrected without compromising diet quality, or when dietary adherence is poor.
- Potential side effects: constipation, bowel necrosis, hypomagnesaemia, edema.
- Be aware of sodium overload if sodium-based resins such as sodium polystyrene sulfonate (sodium resonium) or zirconium cyclosilicate are used.

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