The Egyptian Journal of Hospital Medicine (July 2025) Vol. 100, Page 2933-2936

An Overview on Low Phosphorus Diet

Mohammed Ibrahim Ahmed Eliwa[1]*, Doaa Youssef Mohamed[2], Ahmed Elsayed Wageeh[3]

[1] Pediatrics Department, Faculty of Medicine, Zagazig Fever Hospital, Egypt

[2] Pediatrics Department, Faculty of Medicine, Zagazig University, Egypt

[3] Pediatrics Department, Faculty of Medicine, Suez University, Egypt

***Corresponding author:** Mohammed Ibrahim Ahmed Eliwa, **Email:** drmohamed_2@yahoo.com, **Mobile:** +201147725277

ABSTRACT

Phosphorus is an essential mineral involved in numerous physiological processes, including bone mineralization, energy metabolism (via ATP), acid-base balance, and cellular signaling. It is naturally abundant in many foods, particularly in protein-rich sources such as dairy products, meats, legumes, and nuts, as well as in processed foods containing phosphate additives. A low phosphorus diet is commonly prescribed for individuals with chronic kidney disease (CKD), particularly in stages 3–5, due to the kidneys' reduced ability to excrete phosphorus effectively. Hyperphosphatemia (elevated serum phosphorus) is a frequent complication in CKD and is associated with secondary hyperparathyroidism, vascular calcification, cardiovascular morbidity, and increased mortality. Managing dietary phosphorus intake is thus a cornerstone in the nutritional care of CKD patients. It aims to: Maintain normal serum phosphorus levels, prevent secondary complications like renal osteodystrophy and reduce dependence on phosphate binders. In clinical practice, phosphorus restriction involves limiting high-phosphorus foods, especially those containing inorganic phosphate additives, which are more readily absorbed (up to 90–100%) compared to organic phosphorus in natural foods (~40–60%). Dietitians often tailor phosphorus management plans while balancing other dietary needs, such as protein and calcium intake, to avoid malnutrition. Despite its clinical importance, adherence to a low phosphorus diet can be challenging due to the complexity of food sources, hidden additives, and lack of labeling regulations in many countries.

Keywords: Phosphorus, Low phosphorus diet, Minerals.

INTRODUCTION

Phosphorus is a mineral that's found naturally in many foods and also added to many processed foods. Healthy kidneys remove extra phosphorus from the blood. If the kidneys don't work well, anyone can develop a high phosphorus level in the blood, putting the patient at greater risk of heart disease, weak bones, joint pain and even death [(1)].

How much phosphorus each person needs depends on his kidney function. If a patient has early-stage kidney disease or on dialysis, he may need to limit phosphorus. Nearly every food contains some phosphorus, so this can be hard to do [(2)].

Current guidelines recommend choosing natural foods instead of processed foods that have phosphorus added to them. The body absorbs less of the phosphorus from natural foods, and natural foods offer better nutrition overall. For many years, people who needed to limit phosphorus were told to limit healthy foods such as whole grains, legumes and other plant-based foods. Recent research shows that this isn't necessary [(3)].

Manufacturers may add phosphorus when processing foods to thicken them, improve taste, prevent discoloration or preserve them. So, it is important to check food labels to see whether any ingredients contain phosphorus among the ingredients or not [(3)].

The aim of this review is to evaluate and summarize current evidence on the role and effectiveness of a low phosphorus diet in patients with chronic kidney disease (CKD) and related conditions.

Examples of phosphorus added to food:

- Calcium phosphate.
- Disodium phosphate.
- Phosphoric acid.
- Monopotassium phosphate.
- Sodium acid pyrophosphate.
- Sodium tripolyphosphate [(3)].

It is advisable to check the online ingredient lists or ask your dietitian about alternatives. The best way to limit phosphorus in the diet is to limit foods that contain the most phosphorus, including:

- Fast foods, foods sold at gas stations, and other packaged and convenience foods.
- Cheese, canned or jarred processed cheese spreads, and prepared cheese products in block form.
- Fresh or frozen meats that have added flavor or fluids to keep them moist.
- Cola and pepper-type sodas, many flavored waters, many bottled or canned teas, fruit punch, energy or sports drinks and many powdered drink mixes [(2)].

Low-Phosphorus Diet Guidelines:

Phosphorus buildup can be controlled by cutting down on foods rich in phosphorus. Protein-rich foods tend to have large amounts of phosphorus, but some intake is needed to maintain good health and strong muscles. All foods that come from animals, such as meat and milk, and other non-meat foods, such as dried beans and seeds, are high in phosphorus [(1)].The pathways linking dietary phosphorus and kidney and cardiovascular diseases, as well as mortality, is shown in figure 1.

Received: 12/02/2025
Accepted: 12/04/2025

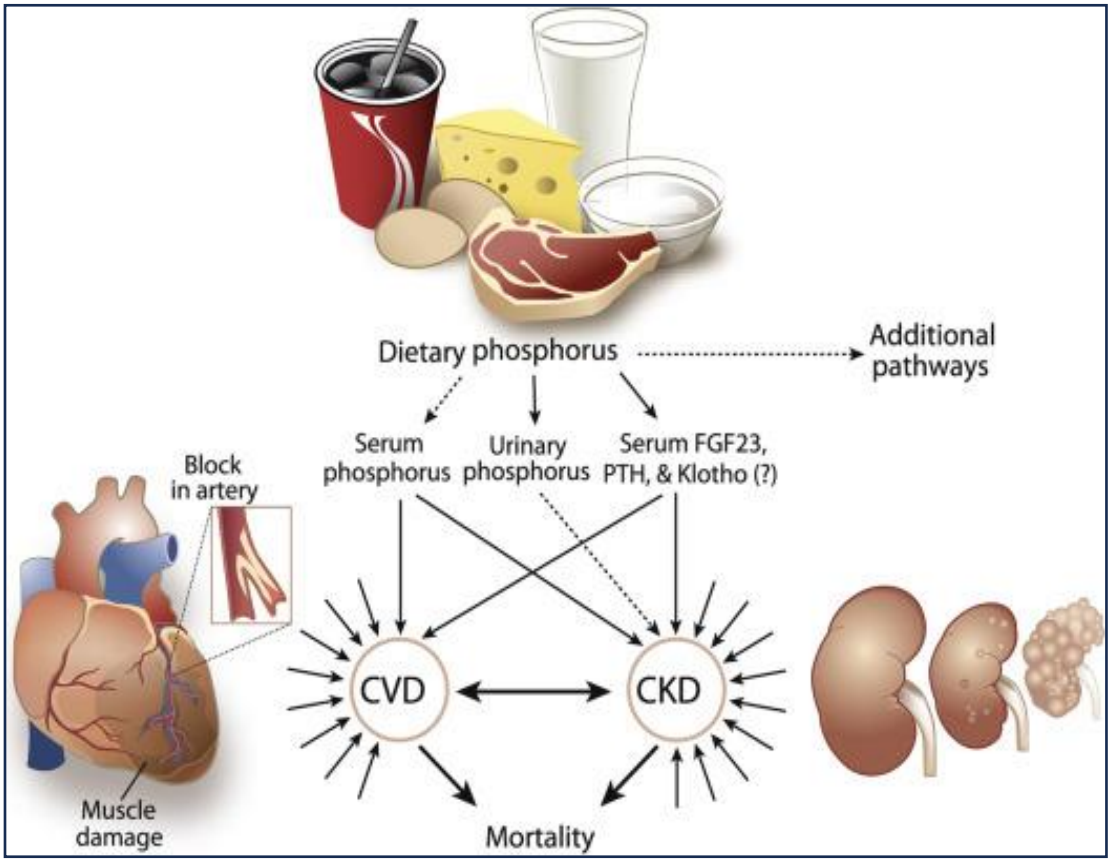

Figure (1): Pathways linking dietary phosphorus to chronic kidney disease (CKD), cardiovascular disease (CVD), and mortality. Solid lines denote established pathways; broken lines denote pivotal pathways [(4)].

It is important to keep consistent and eat the same amount of protein-rich foods daily. Plans for vegetarians or other special diets should be discussed with a registered dietitian. If the blood phosphorus cannot be controlled by diet alone, the patient may need to take a phosphorus binder. These medications must be taken with meals and snacks as prescribed [(3)].

The following list of foods may serve as a guideline.

1) Fruits and vegetables:

Serving size is ½ cup unless otherwise indicated.

To choose 5 - 6 servings per day. Almost all fruits and fruit juices: Green beans, green peas, zucchini, summer squash, butternut squash, cauliflower, carrots, corn, asparagus, brussels sprouts, mixed vegetables that don't contain vegetables, okra, cabbage, tomato (raw) and canned beets.

Notes and Precautions by Age Group:

1. **Ages 2 to 5:**

Vegetables and fruits should be cut into small pieces to avoid choking hazards. Avoid large amounts of corn or peas if the child does not chew well. Juice intake should be limited (no more than 4 oz / 120 ml per day) due to high sugar content.

2. **Ages 6 to 12:**

All listed items are generally fine. Emphasize cooked or steamed vegetables for easier digestion.

3. **Ages 13 to 18:**

All items are suitable, especially important for supporting growth during adolescence. Encourage daily intake of fruits and vegetables for overall health.

To avoid: Artichokes, chickpeas, split peas, lima beans, pinto beans, soybeans, black-eyed peas, canned dried beans, avocados, turnip greens, mushrooms, broccoli, seeds (i.e., sesame, sunflower pumpkin) and baked potato [(2)].

2) Milk and milk products

Serving size is ½ cup unless otherwise indicated

To choose: Up to 4 servings per day: Rice milk-not fortified or enriched with phosphorus (¼ cup), Non-dairy creamer (¼ cup) and cream cheese (28 g or 2 tbsp or 1 oz).

To avoid: Limit to 2 servings per day: Milk, soy milk, cheese (28 g or 2 oz slice), ice cream, milkshakes, macaroni and cheese, yogurt, pudding, cream soups, cottage cheese [(2)].

3) Meat and other protein:

To choose: Whole eggs, fresh meat, fish, beef, chicken or lamb, turkey, shrimp and oysters.

Tips and Warnings:
Meats and fish should be cooked thoroughly to prevent foodborne illnesses. Avoid giving raw or undercooked meat to children. Cut meats into small pieces or finely chop for younger children to make chewing and swallowing easier. Monitor for allergies, especially with seafood like shrimp and oysters. Raw eggs are not recommended for children due to infection risks.
To avoid: Hot dogs, Sardines, Organ meats (i.e., beef/ chicken liver, gizzards), Luncheon meats, Peanut butter, Unsalted nuts, Baked beans, Tofu, tempeh, miso, Veggie or soy patties and Canned tuna [(2)].

4) Breads and other grains
To choose: 6 or more servings per day: Grits, white rice, spaghetti or macaroni, saltine crackers, muffins, bagel, white bread/rolls, pumpernickel or rye bread, corn- and rice-based cold cereals, English muffins and homemade pancakes/waffles (without milk).

Tips and Warnings:
It's best to avoid too many refined grains without fiber, as they may affect digestion in the long term. Ensure these foods are prepared appropriately for the child's age—for example, cutting bagels or muffins into smaller pieces for younger children. Some children may need to avoid wheat products due to allergies or celiac disease, so consulting a doctor is advised. It's preferable to gradually introduce whole grains to increase dietary fiber.
To avoid: Bran cereals, whole wheat cereals, oatmeal, granola, trail mix, wheat germ, whole grain bread, cornbread, pancake made from a mix, frozen or fast food, waffles (frozen) and biscuits [(2)].

5) Other Foods:
To choose: Pound cake, angel food cake, marshmallows, sugar cookies, sugar wafers, sour balls, vanilla wafers, graham crackers, popsicles, jellybeans, gumdrops, rock candy, ginger ale, grape soda, orange soda, cranberry juice, clear sodas, lemonade, fruit punch, sorbet, sherbet, Italian ice, gelatin, popcorn, unsalted pretzels.

Notes and Warnings:
Most of these items contain high amounts of sugar and preservatives, which can lead to health issues such as tooth decay, weight gain, and blood sugar problems if consumed in large amounts or regularly. It is recommended to serve them in moderation and as a very limited part of a balanced diet. Monitor for any allergies or sensitivities, especially with some sweets like marshmallows or gelatin. For young children (under 5 years), some items like hard candies (e.g., rock candy or sour balls) may pose a choking hazard and should be avoided or given with great caution.
To avoid: Chocolate, molasses, cocoa, brown sugar and coconut [(2)].

Renastart Formula in Pediatrics:
Nutritional profile
Renastart™ is a specialized pediatric formula developed by Vitaflo (a Nestlé Health Science Company), tailored for children with chronic kidney disease (CKD). Its formulation addresses the unique metabolic and nutritional demands of this population, particularly those on dialysis [(5)].

One of the critical features of Renastart™ is its low phosphorus content. Hyperphosphatemia is a prevalent complication in pediatric CKD and contributes significantly to secondary hyperparathyroidism and vascular calcification. Renastart™ is designed to limit phosphorus intake, containing approximately 17 mg of phosphorus per 100 kcal substantially lower than the 50–70 mg typically found in standard pediatric formulas. This reduction plays a vital role in minimizing phosphorus burden and managing mineral bone disorders (CKD-MBD) in affected children [(6)].

Protein control is essential in pediatric renal diets to support growth while avoiding the accumulation of nitrogenous waste products. Renastart™ contains approximately 1.5 grams of high-quality whey protein per 100 kcal. This amount is carefully balanced to provide adequate nutrition for growth and tissue repair, while also reducing the metabolic strain on the kidneys. In contrast, standard formulas often contain higher protein levels, ranging from 2.0 to 2.5 grams per 100 kcal, which may not be ideal for children with reduced renal function [(6)].

Renastart™ provides a caloric density of 100 kcal per 100 ml at a 1 kcal/ml dilution, which is suitable for standard use. Importantly, the formula can be concentrated up to 2 kcal/ml when needed, offering valuable flexibility for children with fluid restrictions or increased energy demands. This adaptability is particularly beneficial in managing nutritional intake without exceeding fluid allowance—a common challenge in pediatric dialysis care [(7)].

The formula's electrolyte profile is specifically engineered to minimize disturbances common in CKD. Per 100 kcal, Renastart™ delivers only 19 mg of potassium, 42 mg of sodium, 20 mg of calcium, and 16 mg of chloride. These reduced values help prevent hyperkalemia, hypertension, and other complications associated with electrolyte imbalances in renal failure. Maintaining electrolyte balance is a cornerstone of conservative CKD management, especially in growing children [(8)].

Renastart™ also includes essential long-chain polyunsaturated fatty acids such as docosahexaenoic acid

(DHA) and arachidonic acid (ARA), which are vital for brain and visual development in children. Each 100 g of the formula provides approximately 115 mg of DHA and 200 mg of ARA. These components are particularly important for children with CKD, as their dietary intake may be compromised, and neurodevelopmental outcomes can be at risk due to the chronic nature of their condition [(9)]. To support the comprehensive nutritional needs of children with CKD, Renastart™ is fortified with a broad spectrum of essential vitamins and minerals. This includes vitamin D important for bone metabolism iron, zinc, and other trace elements that are often deficient in pediatric renal patients. These micronutrients are crucial for growth, immune function, and metabolic stability, making their inclusion an essential part of the formula's therapeutic utility [(10)].

Table 1: Comparative Nutrient Profile (Per 100 kcal) [(11)]

Nutrient	Renastart™	Standard Formula*
Protein (g)	**1.5**	**2.0–2.5**
Phosphorus (mg)	**17**	**50–70**
Potassium (mg)	**19**	**80–120**
Sodium (mg)	**42**	**60–90**
Calcium (mg)	**20**	**80–120**

CONCLUSION

A low phosphorus diet plays a critical role in the management of patients with chronic kidney disease (CKD), particularly in slowing disease progression and minimizing complications such as secondary hyperparathyroidism, vascular calcification, and cardiovascular morbidity. The current evidence supports dietary phosphorus restriction as an effective, non-pharmacological strategy to control serum phosphate levels, especially when combined with patient education and individualized dietary counseling.

Conflict of interests: None.
Funding: None.

REFERENCES

1. **Brown B, Bigelow P (2024):** Can a low-phosphate diet for chronic kidney disease treat cancer? An interdisciplinary literature review. Medicines, 11(2):5.
2. **Elser J, Haygarth P (2020):** Phosphorus: Past and future. Oxford University Press.
3. **Byrne N, Gillman A, Kiely M *et al.* (2020):** Pilot randomized controlled trial of a standard versus a modified low-phosphorus diet in hemodialysis patients. Kidney Int Rep., 5(11):1945–55.
4. **Evenepoel P, Vervloet G (2016):** Dietary phosphorus restriction in predialysis chronic kidney disease: Time for a cease-fire? Kidney Int., 89(1):21–23.
5. **Nelms L (2018):** Optimizing enteral nutrition for growth in pediatric chronic kidney disease (CKD). Front Pediatr., 6:214.
6. **UK, Abidec Chefaro S, Adamin G *et al.* (2015):*)** Dietetic products. Clin Paediatr Dietet., 830.
7. **Keung L (2018):** Nutritional considerations for adolescents with chronic kidney disease. In: Adolescents with chronic kidney disease: From diagnosis to end-stage disease, Springer, Cham. p.43–59.
8. **Sharma K, Joshi I (2014):** Formulation of standard and high protein ready-to-reconstitute enteral formula feeds. https://citeseerx.ist.psu.edu/document?repid=rep1&type=pdf&doi=f524238dd56b29134f2d2010c8509e3cfd809aab
9. **Chadha V, Foster J, Mak H *et al.* (2022):** Nutrition, growth, and development. Pediatr Nephrol., 37:1717–49. http://202.45.146.37:8080/jspui/handle/123456789/45
10. **Nelms L, Warady A (2020):** Infancy, childhood, and adolescence. In: Nutrition in Kidney Disease, Humana, Cham. p.357–97. https://doi.org/10.1007/978-3-030-44858-5_20
11. **Drewnowski A, Amanquah D, Gavin-Smith B (2021):** Perspective: How to develop nutrient profiling models intended for global use: A manual. Adv Nutr., 12(3):609–20.
12. **Obeid O (2013).** Low phosphorus status might contribute to the onset of obesity. Obesity reviews, 14(8) :659-664.
13. **Kusano K, Segawa H, Ohnishi R *et al.* (2008).** Role of low protein and low phosphorus diet in the progression of chronic kidney disease in uremic rats. Journal of nutritional science and vitaminology, 54(3):237-243.
14. **Gin H, Aparicio M, Potaux L *et al.* (1987).** Low protein and low phosphorus diet in patients with chronic renal failure: influence on glucose tolerance and tissue insulin sensitivity. Metabolism, 36(11): 1080-1085.