IPI International Potash Institute

Nutrition and Health – the Importance of Potassium

INTERNATIONAL POTASH INSTITUTE
60 ANNIVERSARY 1952-2012

Compiled by Sarit Anavi. Editor: P. Imas

ISBN 978-3-905887-08-2
DOI 10.3235/978-3-905887-08-2

POTASSIUM AND HUMAN HEALTH

Minerals are inorganic substances, present in all body tissues and fluids. Their presence is required to maintain certain physical and chemical processes which are essential to life. For humans, potassium (K) is an essential macro mineral nutrient. Within the body, potassium is the principal cation in intracellular fluid and participates in acid-base balance, regulation of osmotic pressure, conduction of nerve impulses, muscle contraction, cell membrane function and more. The importance of potassium to human health has been well recognized and new studies continue to emphasize its positive effects and its potential use in public health. For example, a high dietary intake of potassium has been shown to protect people from a number of conditions that affect the cardiovascular system, kidneys, and bones.

BLOOD PRESSURE

One of the main beneficial effects of high potassium intake is related to blood pressure control. Hypertension (high blood pressure) is considered a major risk factor for cardiovascular diseases, particularly coronary heart disease and stroke, and it is one of the leading causes of death around the world. Increasing dietary potassium intake is associated with a decrease in blood pressure (Fig.1).

Evidence from a variety of studies has demonstrated that increased potassium intake reduces systolic (maximum) and diastolic (minimum) blood pressure in adults in both hypertensive (high blood pressure) and non-hypertensive patients. However, the reductions in blood pressure tend to be greatest in people who are hypertensive, which emphasizes the potential benefits of increasing potassium intake in these people.

Available evidence also suggests that increased potassium intake may control blood pressure, and consuming more potassium through foods high in potassium would probably be beneficial for most children. A higher intake of potassium also attenuates the adverse effects of sodium on blood pressure. A diet low in potassium, especially when combined with high sodium intake, has been implicated in the development of elevated blood pressure which can subsequently lead to cardiovascular disease. Accordingly, an intake sodium-potassium ratio of approximately 1:1 is considered beneficial. However, in reality the ratio of sodium to potassium many people actually consume is at least 2:1.

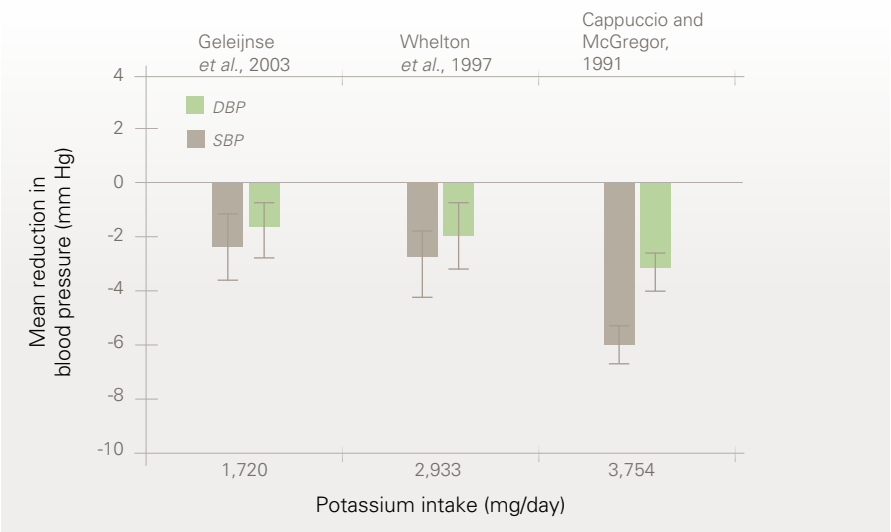


Fig. 1. Overview of meta-analyses of studies investigating the blood pressure lowering effects of potassium. DBP: diastolic blood pressure; SBP: systolic blood pressure. Error bars are confidence interval at p=0.05. Source: Houston and Harper, 2008.

CARDIOVASCULAR DISEASE

Increased intake of potassium has also been implicated in preventing other cardiovascular risks. To date, many studies have suggested that increased potassium intake may decrease the risk of stroke and coronary artery disease (Fig.2). Several key analyses, that have combined the results of several studies, also support these findings, with a recent study suggesting a reduction in the risk of stroke by 21% for every 1,640 mg of potassium consumed per day. These findings have revealed that a higher sodium-potassium ratio is associated with increased risk of cardiovascular diseases and increased mortality from cardiovascular diseases and ischemic heart disease, characterized by a reduced blood supply to the heart. By lowering blood pressure, the beneficial effects of dietary potassium could improve the function of the cardiovascular system.

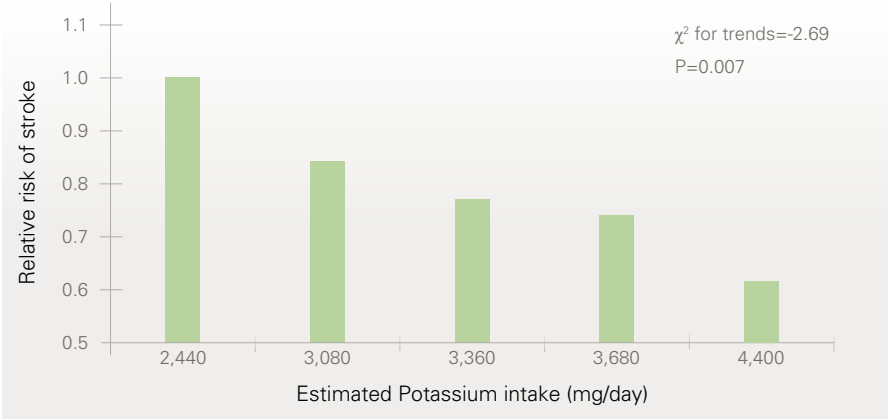


Fig. 2. Potassium intake and adjusted risk of stroke among 43,738 U.S. men aged 40–75 years followed for 8 years. Risk was adjusted for age, total energy intake, smoking, alcohol consumption, history of hypertension, history of hypercholesterolemia, parental history of myocardial infarction before age 65 years, profession, and quintiles of BMI, and physical activity. Source: He and MacGregor, 2001.

BONE HEALTH

Increasing potassium intake through fruit and vegetables has been associated with an improvement in bone health in children, adults and the elderly. Studies on the effects of dietary potassium on bone health have demonstrated a positive association between high intake of potassium and bone mineral density (BMD) and bone mass (Fig. 3). Although the exact mechanism by which potassium benefits the skeleton is still debated, increasing potassium intake conclusively reduces urinary calcium

excretion and improves calcium retention, thus creating a positive calcium balance. This may have a positive impact on bone mass and associated risk of osteoporosis, which represents a significant public health burden worldwide.

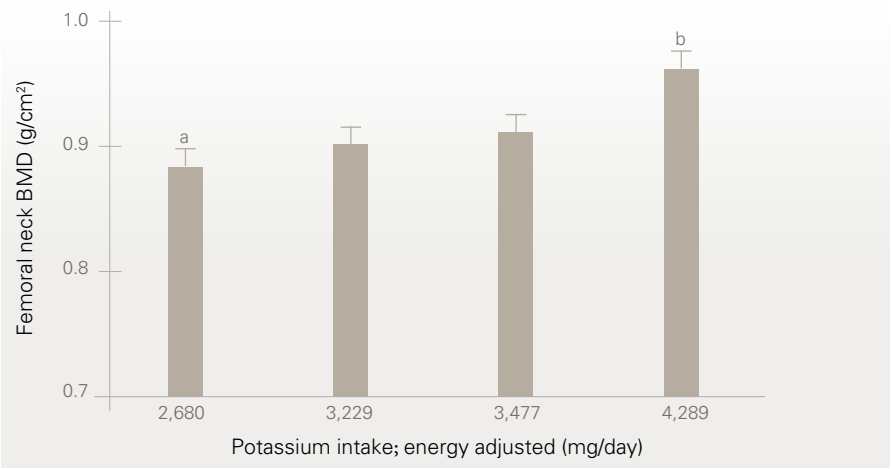
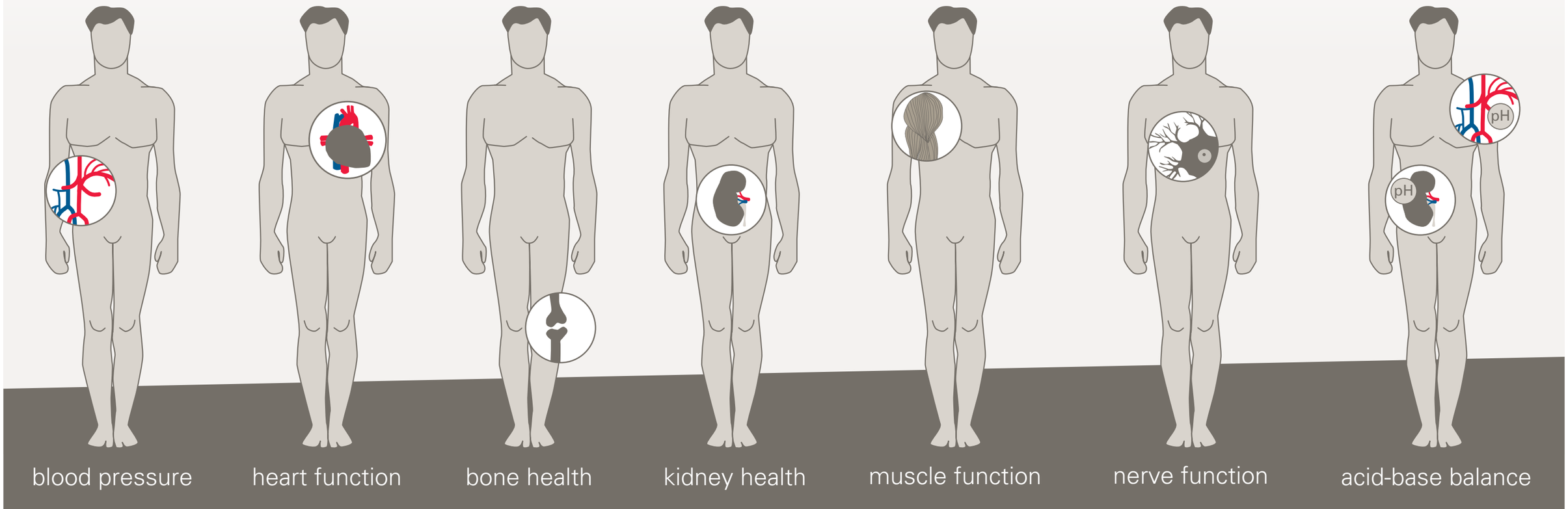


Fig. 3. Mean (±2 SEM) bone mineral density (BMD) of the femoral neck with increasing potassium intake in premenopausal women. Different letters are significantly different (p=0.001). Source: Macdonald et al., 2005.

THE KIDNEY

Abnormally high urinary calcium (hypercalciuria) increases the risk of developing kidney stones. Thus, by reducing urinary calcium excretion, a high potassium intake additionally reduces the risk of kidney stone formation. Large scale studies have demonstrated that high intake of potassium (median of 4,000 mg/day in men and 4,700 mg/day in women) is associated with a reduced risk of kidney stones. Moreover, several lines of evidence also indicate that dietary potassium slows the progression of kidney disease. In hypertensive rats, high potassium intake was shown to prevent damage to the kidney, independent of its effect on blood pressure. Potassium supplementation was also shown to suppress renal inflammation in a rodent model of chronic kidney disease. However, current data on humans is still lacking.

Potassium improves your



blood pressure | heart function | bone health | kidney health | muscle function | nerve function | acid-base balance

TYPE 2 DIABETES

Potassium has also been implicated in Type 2 diabetes which is a growing public health burden globally, leading to disability, mortality and higher healthcare costs. Potassium levels in the blood are highly regulated by the body but can be affected by many factors including intake of dietary potassium. Low levels of potassium in blood serum are linked to a high risk of diabetes. Although low dietary potassium has not been clearly associated with a higher risk of diabetes, increased intake of potassium-rich foods has been associated with a reduced risk of diabetes.

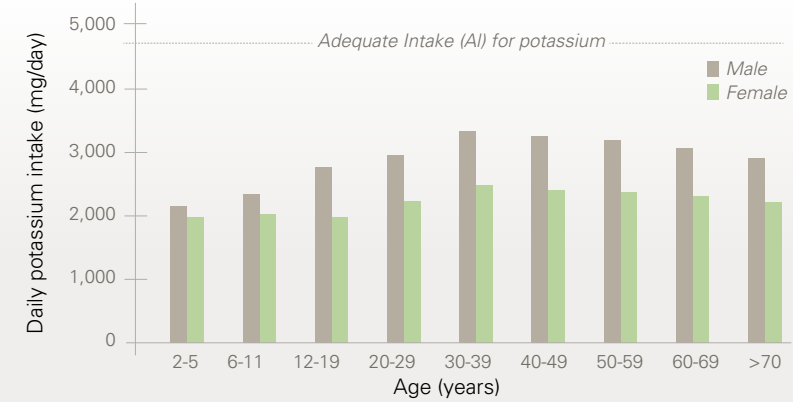
DIET RECOMMENDATIONS

In 2004, the Food and Nutrition Board of the Institute of Medicine established for male and female an adequate intake level (AI) for potassium at 4,700 mg/day (Table 1). Dietary intake of potassium in many modern societies is much lower than this recommended value (Fig. 4). For example, data from the Third National Health and Nutrition Examination Survey (NHANES III) reveals that in the US the potassium intake of only 10% of men, and less than 1% of women, is at least 4,700 mg/day. Potassium is commonly found in a variety of unrefined foods, especially fruits and vegetables, which are the primary source of potassium.

Milk and meat products are also a good source of potassium (Table 2). Food processing reduces the amount of potassium in many food products. Therefore, the western diet, which is characterized by high intake of processed foods and low intake of fresh fruits and vegetables, is often lacking in potassium. Additionally, as foods are processed, sodium is frequently added and potassium is removed, reversing the sodium-potassium ratio. Given the health benefits of adequate potassium intake and its relatively low current intake by the general population, increased intake of dietary potassium is warranted. Consumption of unprocessed, potassium-rich fruits and vegetables is the safest and preferred pathway to increasing potassium intake.

Age group	Adequate intake level for potassium (mg/day)
0 - 6 months	400
7 - 12 months	700
1 - 3 years	3,000
4 - 8 years	3,800
9 - 13 years	4,500
14 -18 years	4,700
> 18 years	4,700
Pregnancy (14 - 50 years)	4,700
Lactation (14 - 50 years)	5,100

Table 1: Dietary recommendation for potassium. Source: Food and Nutrition Board, Institute of Medicine.



4,700 mg/day is the Adequate Intake (AI) for potassium set by the Institute of Medicine. For children younger than 14 years old, AI is less than 4,700 mg/day.

Fig. 4. Estimated mean daily potassium intake by age/sex group, 2005-2006. Source: USDA, ARS, 2005-2006. WWEIA, NHANES. Dietary Guidelines Advisory Committee - Agricultural Research Service, 2010.

Food	Potassium (mg/100g)
Fruits[1]	
Apple	107
Avocado	485
Banana	358
Cherry	222
Dried apricot	1,900
Grapefruit	139
Grape	191
Orange	181
Peach	190
Pear	119
Plum	157
Strawberry	153
Grains[2]	
Barley	470
Corn	370
Oats	440
Rice, white	150
Rye	520
Soybean	539
Wheat	420
Vegetables[1]	
Carrot	320
Celery	260

Food	Potassium (mg/100g)
Vegetables[1]	
Lettuce	141
Lima bean[2]	570
Navy bean[2]	389
Onion	146
Pea[2]	271
Pepper	175
Potato[3]	535
Spinach	558
Tomato	237
Nuts[1]	
Almond	705
Brazil nut	659
Cashew	660
Pecan	410
Pistachio	1,025
Walnut	441
Other	
Cod	516
Dark chocolate	830
Low fat yogurt	234
Milk (semi-skimmed)	154
Orange juice	200
Salmon	628

Table 2: Potassium content of common foods. Source: Bruulsema et al., 2012.

[1]Values from USDA Nutrient Database (2010)
[2]Boiled, with salt
[3]Baked, with skin (updated values)

SAFETY CONSIDERATIONS

In a generally healthy person with normal kidney function, potassium intake from foods that exceed 4,700 mg/day pose no threat of increased risk for health since excess potassium is readily excreted in the urine. Therefore, no tolerable upper intake level for potassium has been set. However, individuals whose urinary potassium excretion is impaired (e.g. individuals with chronic renal insufficiency or Type 1 diabetes) should consume levels of potassium recommended by health care professionals, which may well be lower than the recommended AI.

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INTERNATIONAL
POTASH INSTITUTE

Baumgärtlistrasse 17, P.O. Box 260
CH-8810 Horgen, Switzerland
T +41 43 810 49 22, F +41 43 810 49 25
ipi@ipipotash.org; www.ipipotash.org
twitter.com/IPI_potash; facebook.com/IPIpotash
flickr.com/photos/ipi_potash/sets/