Micro Trace Minerals Laboratory
35+ years of clinical & environmental laboratory diagnostics

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Testing for Sodium and Potassium in Blood, Urine or Hair

1. Sodium and Potassium in Blood

Sodium and potassium are necessary to maintain water balance in the body for proper functioning of the nerves, blood pressure regulation, aiding absorption of major nutrients, regulation of acid-base balance and contraction of the muscles, in addition to other cellular chemical reactions.[i]

ELECTROLYTE DISTRIBUTION			
Electrolyte	Extracellular meq/liter	Intracellular meq/liter	Function
Sodium	142	10	fluid balance, osmotic pressure
Potassium	5	100	Neuromuscular excitability acid-base balance

Extracellular and Intracellular Fluids

- Sodium and potassium concentrations in extra- and intracellular fluids are nearly opposites. This reflects the activity of cellular ATP-dependent sodium-potassium pumps. Potassium levels are mainly controlled by the hormone aldosterone. Potassium levels often change with sodium levels. When sodium levels go up, potassium levels go down, and when sodium levels go down, potassium levels go up.[ii]
- Electrolytes determine the chemical and physical reactions of fluids
- Ion fluxes are restricted and move selectively by active transport
- Nutrients, respiratory gases, and wastes move unidirectionally
- Osmolalities of all body fluids are equal; changes in solute concentrations are quickly followed by osmotic changes

Because Sodium is a major element in extracellular fluid, it is preferably tested in serum.

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Blood Potassium levels can be falsely elevated by a variety of circumstances surrounding specimen collection and specimen processing. For example, if a patient is clenching and relaxing his fist, the potassium level in his blood may increase. If blood samples are delayed in getting to the lab or if the blood tubes are subjected to vigorous shaking or rough handling in transit, potassium may leak from red blood cells and falsely elevate the potassium in the serum.

Other Factors affecting Potassium Levels in blood

- Taking potassium supplements.
- Taking medicines, such as antibiotics that contain potassium (such as benzylpenicillin, also called penicillin g, also called benzylpenicillin, nonsteroidal anti-inflammatory drugs (NSAIDs), heparin, insulin, glucose, corticosteroids, diuretics, medicines used to treat high blood pressure and heart disease, and natural licorice (Glycyrrhiza glabra).
- Overuse of laxatives.
- Severe vomiting.

Potassium measurement in whole-blood specimens may convenient. However, the presence of hemolysis in whole-blood samples cannot be determined by present analytical systems. There is a risk of reporting misleadingly increased whole-blood potassium concentrations for unrecognized hemolyzed samples, with potential for subsequent patient misdiagnosis and mistreatment.[iii] Consequently, potassium is best tested in serum.

2. Sodium and Potassium in Urine

Sodium: Measurement of the urine sodium concentration is vital in determining the integrity of tubular reabsorptive function. Low urine sodium concentration thus indicates not only intact reabsorptive function but also the presence of a stimulus to conserve sodium, whereas a high urine sodium concentration may signify other salt wasting etiologies. It is usually ordered when we need to distinguish between various forms of renal failure and classifying hyponatremia.[iv]

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Sodium urine excretion fluctuates depending on the sodium intake. Conditions associated with increased urine sodium include the following:[vvi]

- Excessive dietary salt
- Diuretic therapy
- Adrenal insufficiency
- Salt-wasting nephropathy
- Acute tubular necrosis
- Analgesic abuse–induced interstitial nephritis
- Syndrome of inappropriate antidiuretic hormone hypersecretion (SIADH)
- Vomiting
- Hypothyroidism
- Postobstructive diuresis
- Hepatic failure
- Congestive heart failure

The reference range for urine sodium is 40-220 mEq/L/24 hours.

Potassium: Measurement of the urine potassium concentration can be done on a 24hr urine sample or a random sample. The usual range for a person on a regular diet is 25 to 125 milliequivalents per liter per day. However, lower or higher urinary levels may occur depending on the amount of dietary potassium.

High urine potassium levels may be due to:

- Acute tubular necrosis
- Cushing syndrome (rare)
- Diabetic acidosis and other forms of metabolic acidosis
- Eating disorders (anorexia, bulimia)
- Low blood magnesium levels (hypomagnesemia)
- Hyperaldosteronism (very rare)
- Renal tubular acidosis
- Use of non-potassium-sparing diuretics

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Low urine potassium levels may be due to:

- Adrenal gland insufficiency
- Hypoaldosteronism
- Certain medications, including beta blockers, lithium, trimethoprim, potassium-sparing diuretics, or nonsteroidal anti-inflammatory drugs (NSAIDs)

Chelation Therapy does not affect potassium. Hence there is no need to include potassium in urine provocation test profiles.

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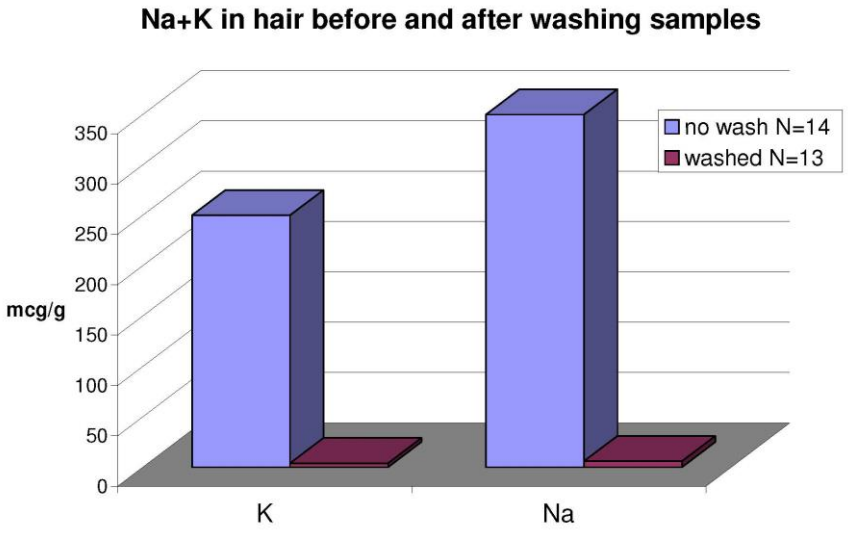
3. Sodium and Potassium in Hair

We do not routinely test sodium or potassium in hair. Our internal studies indicate that sodium and potassium levels of unwashed hair are naturally elevated through sweat, cosmetics or other external factors. Hence, the analysis of unwashed hair samples results in false high sodium values.

With the following experiment, we took a mix of homogenized hair samples and repeatedly tested sodium and potassium prior to washing. We took part of this batch of unwashed homogenized hair, washed and tested them repeatedly until we came to a final sodium and potassium value. As the data indicates, not washing hair will provide falsely elevated results.



Our internal studies indicate that several washing procedures with de-ionized solutions are needed to remove external contaminants such as sodium and potassium. Although Wilson reports that ‘the adrenals and kidneys regulate the hair sodium level’, we could find no evidence. The laboratory he refers to does not wash hair samples prior to testing i.e. external contaminants are not removed.

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While a recent Pakistani study found significantly lower levels of Ca, Mg, and K in the biological samples (blood, serum, and scalp hair) of male and female rheumatoid arthritis patients when compared to referents of both genders,[vii] we see no advantage of testing sodium and potassium in hair rather than serum.

A US laboratory performing Sodium and Potassium analysis in hair states that "Hair measurement should be considered a screening test only; blood testing for Na and electrolyte levels is much more diagnostic and indicative of status."[viii]

When symptoms such as weakness, tiredness, tingling or numbness, nausea or vomiting, abdominal cramping, bloating, constipation or irregular heart beat suggest low potassium, screening in hair only delays proper diagnosis, especially since a quick check for electrolytes in blood makes diagnostic sense.

Hyponatremia is rare, possibly linked to excessive use of diuretics, diarrhea, drinking excess water, or is a result of a disorder in the body's regulation of sodium or water. To diagnose the sodium status, blood diagnosis is a must, possibly including aldosterone or vasopressin levels.

In lieu of all this information, sodium or potassium in hair is not part of our hair profiles.

References:

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[iv] http://emedicine.medscape.com/article/2088449-overview

[v] http://www.nlm.nih.gov/medlineplus/ency/article/003599.htm

[vii] Afridi HI et al. Evaluation of calcium, magnesium, potassium, and sodium in biological samples (scalp hair, serum, blood, and urine) of Pakistani referents and arthritis patients of different age groups. Clin Lab 2012;58(1-2):7-18

[viii] http://www.doctorsdata.com/repository.asp?id=1270