Abstract

Hair testing for deficiencies of vitamins, minerals, macronutrients, and for determining the presence of toxins and toxicants, and identification of allergies and intolerances, is common amongst practitioners of complementary and alternative medicine. However, the scientific evidence suggests that hair testing is neither universally reliable nor valid for determining these and that ‘energy-based’ testing has no basis in science and cannot be recommended.

It is the position of the Holistic Performance Institute that the use of Hair Testing to indicate the presence of exogenous minerals demonstrates validity but the evidence does not suggest a meaningful application of Hair Testing to the diagnosis of allergies or nutrient deficiency. Further research is required for the application of testing with respect to endogenous minerals.

Introduction

Hair analysis is commonly used by complementary and alternative health practitioners to indicate a range of things, from macronutrient, mineral and vitamin deficiencies, through to food allergies and intolerances and even the presence of, or past infection with pathogens. Its use, however, is controversial. Hair analysis is used in mainstream science, specifically in forensic inquiry and the evaluation of poisoning and toxicity. Hair analysis can indicate the presence of a mineral or metal and hence its use for toxicity testing in some cases, although it cannot reliably determine the dose.

Potentially toxic metals such as arsenic, cadmium, cobalt, germanium, lead, lithium, manganese, mercury, nickel, and thallium show relationships between hair and body burden, dosage, and exposure or toxicity and some heavy metal nutrients (chromium, selenium and zinc) may be somewhat reliably measured within hair.¹ Hair mineral analysis specifically is not considered usable for individual diagnostics with two exceptions—arsenic and mercury because of large variations in individual and environmental influences and sources of error of the method of analysis. However, mineral analysis of the hair can be used for cadmium, lead, and zinc to compare a single person with a larger population.²

Methods used in hair testing

A variety of different methods are employed in the testing of hair. Some of these methods are scientifically validated with high sensitivity and specificity. Others are not validated and have
no scientific basis, often relying on imprecise terms like ‘energy-based’ to describe them. It is important to understand which tests are a) valid in their methods and interpretation of results, b) valid in their methods but where the interpretation is challenging or not a good indicator of internal physiological state and c) invalid because they do not employ scientific methods.

1. Testing for non-essential elements
One method that is commonly used for the testing of metals that are not physiologically desirable is inductively coupled plasma–mass spectrometry (ICP-MS). This is a highly sensitive and specific method that identifies how much of what metals are present. If those metals are not supposed to be in the body, then it is useful to know that they are to remove them. In this case, the correlation between the quantity excreted in hair and the quantity in the body is not critically important, as the metal is undesirable and its presence, along with a medical history and other tests, may warrant treatment to remove it. This method is used for forensic and medical identification of undesirable heavy metals.

2. Testing for essential elements
Testing for essential elements is usually by the same scientifically valid methods as for non-essential elements. The interpretation of the results is more challenging, due to the necessity of the presence of these elements in the body.

The main issue with essential element hair testing is related to whether hair levels correlate in a meaningful way with blood concentrations and body status, i.e. does the body excrete minerals into hair proportionally to the body status?

3. ‘Energy-based’ testing
Various forms of energy based testing have become popular in CAM. Some of these are used to test hair. The techniques employed are often not clearly defined and descriptions of the methods are vague and use confounding language. As these have no basis in science, they are not supported in this position statement.

Complications in hair testing
There are many complications that may affect the viability of hair tissue analysis.

1. The type of hair tested
Due to significant variation in tissue variation the site, distance from skin and hair type need to be standardised, and this has not been tested or validated.

2. Time to test
The time between the hair being taken and testing will affect the viability of many results, especially those of water soluble vitamins.

3. Exposure to other elements
Hair dyes, shampoos, soaps and conditioners, pollution, and the presence of varying levels of minerals in tap water, can all affect the viability and results from a hair test. This poses another significant challenge to the validity and standardisation of test results.

4. Stripping of components in hair
The factors mentioned above, along with handling and environmental conditions can all serve to strip some of the structural components of hair and thus the minerals, vitamins or other nutrients or toxins that they may contain.

5. Variation between individuals and lack of standardisation

There is considerable variation between the mineral levels found in hair, and there currently is very poor standardisation currently between labs, within labs and with any accepted reference ranges for hair testing and how that might relate to organ, blood and other mineral or vitamin content.

6. Loss of analytes

Many of the vitamins are sensitive to degradation by oxidation (E and C), light (vitamins A, E, K, B6, and B12) and heat (folate and Vitamin C). As hair is subjected to many of these stresses in day to day life, but the intensity and quantity of these are very much determined by personal habits and behaviours, it is impossible to adjust nutrient losses in any hair vitamin analysis results, rendering them unusable.

Analytes are lost from hair as it ages, i.e. the further away from the scalp it is, the lower the concentrations of analytes.

7. Pigmentation of hair

The pigmentation chemicals in hair (various melanins) affect how different chemicals are retained in hair by providing binding sites for analytes. Blonde and grey/white hair contain less or no melanin and therefore retain fewer compounds.

8. Curly or straight hair

Curly and straight hair may bind metals differently as genetic differences lead to structural differences in the follicle.

9. Age, gender, ethnicity, geographic location, personal habits, seasonal fluctuations, hair growth cycle phase, genetic polymorphisms, inter-element correlations and competition, and chemical speciation.

Evidence for and against hair testing

Evidence from systematic reviews suggests that hair mineral analysis may be a reliable indicator of zinc status. Some heavy metals (especially cadmium, lead and magnesium) that are environmental pollutants may disturb behaviour in children and adults. It is possible that higher levels of lead, cadmium, mercury, copper, iron, silicon, and lowered levels of lithium (as determined by hair test) may be correlated with behavioural difficulties. Hair analysis is considered a useful test for determining mercury intoxication. A correlation has also been noted between high levels of aluminium, arsenic, cadmium, mercury, antimony, nickel, lead, and vanadium in hair and autism symptoms in children, and possibly in conjunction with low levels of zinc and magnesium.

Some minerals such as arsenic, selenium, and probably iodine, zinc, sodium, and vanadium contribute to regulation of cancer, and it has been suggested that hair analysis and multiple logistic regression analysis are potential tools for estimating cancer risk, although this is highly speculative.

Accumulations of manganese, iron, lead, cadmium, and aluminium in hair from Mongolian men (compared to a Japanese control) were correlated with arthritis and...
Parkinsonism, and concentrations of calcium, magnesium, iron, and manganese may be higher in the hair of female patients with fibromyalgia.

It is important to note that these results are highly preliminary and do not provide causative evidence.

A study published in the *Journal of the American Medical Association* in which hair samples from two healthy teenagers were sent under assumed names to 13 commercial laboratories performing multi mineral hair analysis showed that the reported levels of most minerals varied considerably between identical samples sent to the same laboratory, and from laboratory to laboratory.

Seidel and colleagues sent a sample of hair to six laboratories for analysis. 10-fold differences in mineral concentrations were reported by the labs with statistically significant (P<.05) extreme values reported for 14 of the 31 minerals analysed. Differences were also found in laboratory sample preparation methods, calibration standards, and reference ranges used by the individual labs, with conflicting dietary and supplement advice provided based on the results. A study conducted in Germany concluded similarly that the extreme variations in results between labs make hair testing an unreliable testing method. A more recent (2013) study conducted in Korea sent samples from a young male to three different labs noting similar procedures and methods and similar test results. However, a lack of standardisation of reference ranges was still present.

In 2008 Brazilian researchers attempted to determine the relationship of hair levels of minerals to blood levels. For copper, manganese, and strontium there was no correlation between levels in hair and blood. The authors concluded there was little value in hair analysis for determining copper, manganese, strontium, or lead exposure.

A 2004 review published in the journal *Allergies* found that verified allergies were seldom picked up by hair analysis in most labs, with significant findings of false allergies, for example, the ability to diagnose allergic disease was studied in nine fish-allergic and nine control subjects, who provided specimens of blood and hair for testing. All fish-allergic subjects had previously been shown to have a positive skin prick test to fish. The specimens were submitted as coded, duplicate samples to five laboratories which all offer a commercial service in carrying out diagnostic tests for allergies. All five laboratories were not only unable to diagnose fish allergy but also reported many allergies in apparently non-allergic subjects and provided inconsistent results on duplicate samples from the same subject.

An attempt has also been made to correlate body levels of minerals with hair analysis in autopsies. A significant correlation was found between mercury levels in hair and in the kidney. However, only weak associations were found between hair levels of mercury and selenium with liver concentrations. Overall mineral concentrations between tissue types varied enormously (in some cases more than 5000-fold), and it was concluded that except mercury and possibly selenium that hair analysis does not provide a useful measure of trace element status.

**Conclusion**

Certain analytes and methods in hair testing provide valid and useful information to the practitioner. This is most useful for exogenous
minerals that are not desirable in the body in quantity.

Endogenous minerals in hair analysis by validated methods may have some validity, but the data to support the correlation between the amount excreted in hair and the status of the body is not robust enough to be useful, in most cases.

Measuring vitamins in hair is not useful due to a lack of data regarding excretion of vitamins into the hair and the degradation of many vitamins within the hair. These tests are also generally energetic in nature and not scientifically validated.

Any hair test that relies on ‘energy-based’ methods has no scientific rationale. These typically claim to measure macronutrient and all micronutrient status, allergies, candida, SIBO and disease states.

If hair analysis demonstrated efficacy, validity, and credibility in scientific explorations, it would be an extremely useful clinical tool for CAM practitioners because it is non-invasive and convenient. However, it has not yet been demonstrated to be reliable or accurate, let alone valid to consistently reflect the status of trace elements, vitamins or macronutrients in the body. At this time, we do not have accurate reference ranges for hair analysis and the variation between tests and the comparison with serum or other tissue samples which make it difficult to use diagnostically for the few minerals for which it may offer a more reliable test. 28, 29

Similarly, it is not a reliable measure of allergy or disease status and may serve to confuse clients and patients. This confusion carries a degree of risk for the patient or client as diagnoses of deficiencies, toxicity and allergy that are incorrect may expose the client to unnecessary restriction, increased costs (due to the provision of treatments and consultations) and potentially unsafe or ineffective treatments and treatment protocols.

Evidence for the utility of hair testing, especially for the range of outcomes that many purveyors claim, is simply not backed by credible evidence, and we agree with the statement; “there are so many confounding factors that influence these measurements that isolated individual results cannot be relied upon. Their current value is in epidemiological studies.”

References