Alles, was gelb markiert ist, muss nicht übersetzt werden.

**hTMA in der Wissenschaft – Literaturhinweise**

In diesem Dokument finden Sie eine Liste der wissenschaftlichen Literatur in Bezug auf Haarmineralanalyse (hair Tissue Mineral Analysis; hTMA). Die Liste hat keinen Anspruch auf Vollständigkeit. Wir werden neue Literaturhinweise hinzufügen, sobald die entsprechenden Dokumente öffentlich zugänglich sind.

**Inhalt**

1. [Zitate](http://nutritionalbalancing.org/center/htma/science/articles/htma-references.php#p-00) (Kommentare) aus Berichten und Forschungsarbeiten.
2. [Bücher](http://nutritionalbalancing.org/center/htma/science/articles/htma-references.php#p-01) über Haarmineralanalyse (hTMA), Ernährung und das grundlegende Mineralstoffgleichgewicht.
3. [Medizinische Fachzeitschriften, Artikel und Berichte.](http://nutritionalbalancing.org/center/htma/science/articles/htma-references.php#p-02)

**Zitate (Kommentare) aus Berichten und Forschungsarbeiten.**

Seit 1965 hat die Internationale Atomenergie-Organisation (IAEA) verschiedene Forschungsprogramme zur Untersuchung und Bestimmung von Spurenelementkonzentrationen im Haar umgesetzt. Diese Forschungsprogramme wurden unter der Bezeichnung „Atomare Methoden zur Analyse von Verunreinigungen im menschlichen Haar“ koordiniert. Die IAEA entschied sich für die Analyse anhand von Haar aufgrund der Mineralstoffkonzentration im Haar und der Informationen über externe und interne Kontamination, die im Haar enthalten sind. Der Großteil der Daten in Bezug auf Spurenelementkonzentrationen wurde aus Kopfhaarproben gewonnen.

*Ryabukhin, T.S.: International Coordinated Program on Activation Analysis of Trace Element Pollutants in Human Hair. Hair, Trace Elements, and Human Illness. Brown, A. C.; Crounse, R. G., ed. Praeger Publications, 1980.*

Bioassays von Haaren sind sinnvoll, da Haar ein wirksamer Biokonzentrator ist, Haarproben leicht gelagert werden können, die Konzentration einen integrierten Wert darstellt und schließlich, weil die Messung des (234)U/(238)U-Isotopenverhältnisses in aufgelöstem Haar mittels MC-ICPMS möglich und äußerst informativ ist.

*Karpas Z, Lorber A, Sela H, Paz-Tal O, Hagag Y, Kurttio P, Salonen L., Measurement of the 234U/238U ratio by MC-ICPMS in drinking water, hair, nails, and urine as an indicator of uranium exposure source. Health Phys. 2005 Oct;89(4):315-21.*

Menschliches Kopfhaar ist eine Faser, in der Stoffwechseländerungen vieler Elemente über lange Zeiträume gespeichert werden und untersucht werden können, sodass sich der Ernährung nachgelagerte Ereignisse verfolgen lassen.

*Strain, W. H.; Pories, W. J.; Flynn, A.; Hill, O. A.: Trace Element Nutriture and Metabolism Through Head Hair Analysis. Trace Substances in Environmental Health. Hemphill, D. D., ed. University of Missouri Press, Columbia, 1972.*

Es ist gut belegt, dass ein Mineralstoffmangel in der Ernährung die neurologische Entwicklung beeinträchtigen kann. Der Mangel einiger vorübergehender Nährstoffe in der Ernährung kann im späteren Leben zu Gesundheitsproblemen führen. Ein Übermaß kann jedoch ebenso schädlich sein. Zu diesen Nährstoffen zählen Eisen, Kupfer, Mangan, Zink und andere. Schwermetalle wie Blei, Cadmium, Quecksilber und Arsen sind gleichzeitig Neurotoxine und können die neuronale Entwicklung beeinträchtigen sowie der Gesundheit im späteren Leben schaden, wenn sie in frühen Lebensphasen präsent sind. Sie werden als *fötale Krankheitsursachen* bezeichnet. Es wurde festgestellt, dass die Konzentration von Cadmium im Haar von Kindern mit geistiger Behinderung, Lernschwäche, Dyslexie und vermindertem IQ niedriger war als bei Referenzgruppen.

*Metals and Neurotoxicology. Wright, RO, et al. J. Of Nutr. 138,12, 2007.*

Mineralstoffanalysen von Haar, Blut und Urin bei Diabetespatienten zeigten im Vergleich zur nicht-diabetischen Kontrollgruppe, dass die durchschnittlichen Zink-, Mangan- und Chromwerte im Blut und Kopfhaar von Diabetikern signifikant niedriger waren. Auch höhere Kupfer- und Eisenwerte wurden im Kopfhaar der Diabetikergruppe festgestellt.

*Copper, Chromium, Manganese, Iron, Nickel and Zinc Levels in Biological Samples of Diabetes Mellitus Patients. Kazi, TS, et al. Biol. Trace Elem. Res. 122,1, 2008.*

Die statistische Bewertung dieser Daten mittels multivarianter Varianzanalyse (MANOVA) unter Verwendung einer Kontrastmatrix und mittels Diskriminanzanalyse hat gezeigt, dass elementare Haaranomalien zur korrekten Diagnose der oben genannten Pathologien herangezogen werden können. Dies ist ein Beleg für die Nützlichkeit der Haaranalyse als ergänzendes Mittel zum Nachweis von Störungen des Calcium-/Knochen-Stoffwechsels.

*Miekeley, N., et al. Elemental Anomalies in Hair as Indicators of Endocrinologic Pathologies and Deficiencies in Calcium and Bone Metabolism., J. Trace Elem. Med. Biol. 15, 1, 2005*

Der Konsens der meisten Menschen, die in diesem Feld arbeiten, ist, dass die Daten von Haarpoben zuverlässig sind, wenn diese korrekt entnommen, gereinigt, für die Analyse vorbereitet und mithilfe der besten Analysemethoden unter Verwendung der erforderlichen Standard- und Leerproben in einem sauberen und zuverlässigen Labor durch erfahrenes Personal analysiert werden.

*Toxic Trace Metals in Mammalian Hair and Nails. United States Environmental Protection Agency Publication 1979; EPA-600/4: 79: 049*

In einer Studie an Männern über einen Zeitraum von dreizehn Jahren wurde festgestellt, dass mit jedem im Haar nachgewiesenen Mikrogramm an Quecksilber das Risiko akuter koronarer Ereignisse um durchschnittlich elf Prozent und die Sterberate aufgrund von Herz-Kreislauf-Erkrankungen um zehn Prozent steigt.

*Mercury as a Risk Factor for Cardiovascular Disease. J. Nutr. Biochem. 18, 2007.*

Ein Beispiel dafür, wie sich die Aufnahme von Mineralstoffen im Haar widerspiegelt, wurde in einer Studie an mehreren tausend irakischen Bauern gezeigt, deren Ernährungsplan stark mit Fungiziden behandeltes Getreide umfasste. Die Fungizide enthielten organisches Quecksilber, welches am stärksten im Haar vorhanden war, wenn der Konsum am höchsten war, und die niedrigsten Werte aufwies, wenn der Konsum am niedrigsten war. Die Konzentrationen im Haar wiesen eine direkte Korrelation mit dem Ausmaß der Symptome auf.

*Al-Shahristani, H.; Al-Haddad, I. K.: Mercury Content of Hair From Normal and Poisoned Persons. J Radioanalytical Chem 1973; 15. Al-Shahristani, H.; Shihab, K. M.: Variation of Biological Half-Life of Methylmercury in Man. Arch Environ Health 1974; 28.*

Haarproben aus fünf Ländern (USA, Kanada, VR China, Bangladesch und Nepal) mit bekannten Arsenquellen mit sowohl hoher als auch niedriger Konzentration wurden entnommen und analysiert. Die Arsenkonzentration in allen Haarproben korrelierte mit der Arsenbelastung des Trinkwassers und zeigte die geringe Aufnahme von Selen in Bereichen mit hohen Arsenkonzentrationen. Die Ergebnisse zeigen die Anwendbarkeit von Haaranalysen für das nicht-invasive Biomonitoring bei der Bewertung von ernährungsbedingter Se- und umweltbedingter As-Exposition.

*Spallholz JE, Boylan LM, Palace V, Chen J, Smith L, Rahman MM, Robertson JD., Arsenic and Selenium in Human Hair; A comparison of Five Countries With and Without Arsenicosis., Biol Trace Elem Res. 2005 Aug;106(2):133-44.*

Die Verbreitung von Spurenelementanalysen zur biologischen Erforschung von Ernhährungs,- Wachstums-, Entwicklungs- und Krankheitsprozessen hat dazu geführt, dass die Spurenelementanalyse (mittels Haaranalyse) nicht nur als Mittel zur Bewertung und Einschätzung zum aktuellen Zeitpunkt sondern auch als Technik zur Rekonstruktion zurückliegender biologischer Ereignisse im Organismus herangezogen wird.

*Gilbert, R. I.: Trace Elements in Human Hair and Bone. Hair, Trace Elements and Human Illness Brown, A.C.; Crounse, R. G. ed. Praeger Publications, 1980.*

Diese Studie wurde durchgeführt, um einen Zusammenhang zwischen Elementen im Serum, in den roten Blutkörperchen und im Haar herzustellen, und umfasste einhundertvierundsiebzig Kinder. Anhand von Tests wurden die Konzentrationen der Schwermetalle Cadmium und Blei sowie Calcium, Magnesium, Kupfer, Zink und Eisen gemessen. Die Konzentrationen von Cadmium und Blei lagen im Serum und in den roten Blutkörperchen innerhalb des zulässigen Bereichs, im Haar hingegen wurde das Maximum überschritten. Bei Kindern mit erhöhten Schwermetallwerten wurde eine Nahrungsergänzung mit Magnesium und Vitamine B6 gestartet. Nachsorgetests zeigten eine markante Verminderung der Blei- und Cadmiumkonzentration im Haar und in den Erythrozyten.

*Concentrations of Selected Bioelements and Toxic Metals and Their Influence on Health Status of Children and Youth Residing in Szczecin. Kedzierska, E. Ann. Acad. Med. Stetin. 49, 2003.*

Die Bedeutung der Haaranalyse als biologischer Indikator für die anormale Aufnahme von Spurenelementen beim Menschen wurde bestätigt. Geographische Variationen der Konzentrationen von Spurenelementen im Haar hängen im Großen und Ganzen von den geochemischen Bedingungen oder ernährungsbedingten Faktoren ab.

*Batzevich VA., Hair trace element analysis in human ecology studies., Sci Total Environ. 1995 Mar 15;164(2):89-98.*

Die Ergebnisse der Forschungsstudie zeigen, dass Haarmineralanalyse als diagnostisches Werkzeug bei der Untersuchung der Exposition gegenüber Spurenelementen sowie deren abnormaler Aufnahme über die Nahrung nützlich sein kann und möglicherweise beim Studium bestimmter mentaler Zustände hilfreich ist. Haarmineralanalyse kann Mineralstoffungleichgewichte im Körper aufzeigen, die evtl. durch Zugabe von Mineralstoffen im Rahmen des Ernährungsplans korrigiert werden können. Haarmetallanalyse ist ein faszinierendes, neues Diagnose-Werkzeug und liefert häufig unerwartete Hinweise auf Mineralstoffungleichgewichte im Körper. Die Autoren stützen sich bei dieser Aussage auf die Ergebnisse aus den bisher gesammelten Daten.

*Barlow, P. J.; Kapel, M.: Metal and Sulfur Contents of Hair in Relation to Certain Mental States. Hair, Trace Elements, and Human Illness Brown, A.C.; Crounse, R. G., eds. Praeger Publications, 1980.*

Durch Anwendung statistischer Mustererkennungsmethoden wurde festgestellt, dass die Konzentrationen von Spurenelementen im Haar die verschiedenen Genesungsphasen von NPC-Patienten erstaunlich gut widerspiegeln.

*Leung PL, Huang HM., Following the recovery of naso-pharyngeal cancer patients by trace elements in hair using statistical pattern recognition methods., Biol Trace Elem Res. 1998 Jun;62(3):235-53.*

Wir vermuten, dass der geänderte Status der Elemente Zn, Mg und Cu im Haar als Indikator bei der Diagnose von Epilepsiepatienten dienen kann.

*Ilhan A, Uz E, Kali S, Var A, Akyol O., Serum and hair trace element levels in patients with epilepsy and healthy subjects: does the antiepileptic therapy affect the element concentrations of hair?, Eur J Neurol. 1999 Nov;6(6):705-9.*

Quecksilber, Cadmium und andere Schwermetalle haben eine starke Fähigkeit zur Bindung mit Thiolgruppen und inaktivieren Enzymreaktionen, Aminosäuren und schwefelhaltige Antioxidantien. Cadmiumkonzentrationen in den Nieren verursachen Nierenfunktionsstörung und fördern Bluthochdruck aufgrund von Natriumretention, Glucoseunverträglichkeit, Dyslipidämie und Zinkmangel. Die Schwermetalltoxizität sollte bei jedem Patienten mit Hypertension, Herz-Kreislauf-Erkrankung oder anderen Gefäßerkrankungen beurteilt werden. Es sollten spezifische Tests auf akute und chronische Toxizität sowie die Gesamtbelastung des Körpers anhand von Haar, Nägeln, Urin und Serum mit Vergleichswert und provozierter Bewertung durchgeführt werden.

*The Role of Mercury and Cadmium Heavy Metals In Vascular Disease, Hypertension, Coronary Heart Disease and Myocardial Infarction. Houston, MC. Altern. Ther. Health Med. 13,2,2007.*

Verschiedene Änderungen der Menge von Spurenelementen in biologischen Proben von Patienten mit idiopathischer Skoliose sind nicht zufällig. Was zu einer Wissensverschiebung führen könnte, ist die Speziierung verschiedener Formen von Spurenelementen im Organismus im Zusammenhang mit idiopathischer Skoliose.

*Changes of Selenium, Copper and Zinc Content in Hair and Serum of Patients with Idiopathic Scoliosis. Dastych, M, et al. 2008 Orthopedic Research Society. Wiley Periodicals, Inc. J. Orthop. Res.*

Woraus Haar besteht, hängt von den Substanzen ab, die von externen Quellen und aus dem Blut aufgenommen werden.

*Hopps, H. C.: The Biological Bases for Using Hair and Nail for Analysis of Trace Elements. Sci Tot Environ 1977; 7.*

Mithilfe der Analyse von Blut, abgesonderten Nebenprodukten und menschlichem Haar kann die Menge an Elementen im Körper bestimmt werden.

*Pihl, R. O.; Drake, H.; Vrana, F. Department of Psychology, McGill University, Montreal, Quebec, Canada.: Hair Analysis in Learning and Behavior Problems. Hair, Trace Elements, and Human Illness. Brown, A. C.; Crounse, R. G., eds. Praeger Publications, 1980.*

Es wurde also beobachtet, dass es eine positive Korrelation zwischen der Menge an Elementen im Haar und in den Nägeln einerseits und KHK, Bluthochdruck und Diabetes der betroffenen Patienten andererseits gibt.

*Sukumar A, Subramanian R., Elements in hair and nails of urban residents of New Delhi. CHD, hypertensive, and diabetic cases., Biol Trace Elem Res. 1992 Jul;34(1):89-97.*

Die Chromwerte im Haar wurden bei einer Population gesunder älterer Menschen und einer gleichaltrigen Vergleichsgruppe mit Typ-2-Diabetes analysiert. In der Diabetes-Gruppe wurden niedrigere Chromwerte im Haar beobachtet.

*Longitudinal Hair Chromium Profiles of Elderly Subjects with Normal Glucose Tolerance and Type 2 Diabetes Mellitus. Stupar, J., et al. Metabolism. 56,1, 2007.*

Ein Hybrid-Algorithmus wurde für den Vergleich der Mineralstoffe im Haar einer Gruppe gesunder Menschen mit denen von Diabetikern angewandt und stellte sich als guter Symptomindex zur Feststellung von Menschen mit Typ-2-Diabetes heraus.

*Hybrid Progressive Algorithm to Recognize Type II Diabetes Based on Hair Mineral Contents. Huang, H, et al. Conf. Proc. IEEE, Eng. Med. Biol. Soc. 5, 2005.*

Die Blei- und Quecksilberwerte wurden in einundachzig Haar- und Blutproben ermittelt, die Neugeborenen bei der Geburt entnommen wurden. Die Ergebnisse zeigten, dass Quecksilber und Blei im Haar negativ mit der Calciumpumpenaktivität in den Erythrozyten von Mutter und Nabelschnur korrelieren.

*Hair Mercury Negatively Correlates with Calcium Pump Activity in Maternal and Cord Blood Erythrocytes. Huel, G, et al. Environ. Hlth. Perspect. 116,2, 2008.*

Es wurde ein Zusammenhang zwischen höheren Magnesiumwerten im Serum und niedrigerer Kochenmineraldichte an der Wirbelsäule festgestellt. Gleichzeitig gab es einen Zusammenhang zwischen höheren Magnesiumwerten im Haar und höherer Kochenmineraldichte. Laut Schlussfolgerung der Studie bestand ein Zusammenhang zwischen Magnesium im Serum und Haar einerseits und der Knochenmineraldichte bei prämenopausalen Frauen andererseits, wobei das Calcium/Magnesium-Verhältnis im Serum ein signifikanter Indikator für die Kochendichte zu sein scheint.

*Associations of Calcium and Magnesium in Serum and Hair with Bone Mineral Density in Premenopausal Women. Song, CH, et al. Biol. Trace Elem. Res. 118, 1, 2007.*

Die Werte für Eisen, Zink und Selen im Haar waren im Vergleich zur Kontrollgruppe niedriger in der Studiengruppe aus zweiundfünfzig Kindern mit diagnostizierter Anämie.

*Serum and Hair Levels of Zinc, Selenium, Iron, and Copper in Children with Iron Deficiency Anemia. Gugoze, MK, et al. Biol. Trace Elem. Res. 111, 2006.*

Die Zink-Analyse kürzlich gewachsenen Haares dient als Biomarker für den Zink-Status der letzten Zeit.

*Rush E, Li L, Chandu V, Whiting R., Hair zinc concentrations not subject to seasonal variation in adults in New Zealand., Biol Trace Elem Res. 2003 Dec;95(3):193-202.*

Diese Daten bestätigen, dass die Zn-Haaranalyse zusätzlich zu konventionellen Methoden bei der Bewertung des Ernährungsstatus von Menschengruppen verwendet werden kann.

*Contiero E, Folin M., Trace elements nutritional status. Use of hair as a diagnostic tool., Biol Trace Elem Res. 1994 Feb;40(2):151-60.*

Es wurde berichtet, dass die Mengen bestimmter wichtiger Spurenelemente in der Ernährung den Konzentrationen der Elemente im Haar entsprechen.

*Reinhold, J. G.; Kfoury, G. A.; Ghalambor, M. A.; Jean, C.: Zinc and Copper Concentrations in Hair of Iranian Villagers. Am J Clin Nutr 1966; 18. Strain, W. H.; Steadman, L. T.; Lankau, C. A.; Berliner, W. P.; Pories, W. J.: Analysis of Zinc Levels in Hair for the Diagnosis of Zinc Deficiency in Man. J Lab Clin Med 1966; 68.*

Bei mehr als dreihundert erwachsenen Frauen mit niedrigem, mittlerem bis hohem BMI wurde eine Haarmineralanalyse durchgeführt. Zwischen Frauen mit niedrigem BMI und Frauen mit hohem BMI wurden signifikante Unterschiede bei den Zinkwerten festgestellt. Die adipöse Gruppe wies die niedrigsten Zinkwerte sowie die niedrigsten Verhältnisse von Natrium/Kalium, Eisen/Kupfer und Zink/Kupfer auf. ...wir vermuten, dass die Konzentrationen von Ca, Cu, Fe, Mg, K, Na und Zn im Haar mit dem BMI erwachsener Frauen korrelieren, es sind jedoch weitere Studien erforderlich.

*Wang, CT, et al., Concentrations of Calcium, Copper, Iron, Magnesium, Potassium, Sodium and Zinc in Adult Females hair with Different Body Mass Indexes in Taiwan., Clin. Chem. Lab. Med. 43, 4, 2005*

Die Mengen an Blei, Cadmium und Nickel in Kopfhaar-, Blut- und Urinproben war bedeutend höher bei Gruppen exponierter Arbeiter im Vergleich zu denen einer Kontrollgruppe. Die Feststellung toxischer Metalle in biologischen Proben von Menschen ist ein wichtiges, klinisches Screeningverfahren.

*Evaluation of Toxic Metals in Biological Samples (Scalp Hair, Blood and Urine) of Steel Mill Workers by Electrothermal Atomic Adsorption Spectrometry. Afridi, HI, et al. Toxicol. Ind. Hlth. 9, 2006.*

Die Mineralstoffmengen von einhundertzwanzig männlichen Lungenkrebspatienten wurden mit denen einer Kontrollgruppe aus einhundertfünfzig Studienteilnehmern verglichen. Die Studie zeigte, dass die durchschnittliche Cadmiumkonzentration im Blut und Kopfhaar von Lungenkrebspatienten in verschiedenen Stadien im Vergleich zur Kontrollgruppe erhöht war.

*Determination of Cadmium in Whole Blood and Scalp Hair Samples of Pakistani Male Lung Cancer Patients by Electrothermal Atomic Absorption Spectrometer. Kazi, TG, et al. Sci. Total Environ. 389,2, 2008.*

Haarmineralanalysen von einhundertzwanzig Menschen wurden durchgeführt. In der Behandlungsgruppe wurden Magnesium und Vitamin B6 als Ergänzungsmittel verabreicht. Die Kontrollgruppe erhielt Placebos. Wiederholte Haarmineralanalyse zeigte, dass sich die Ergänzungsmittel positiv auswirkten. Die Magnesiummenge im Haar erhöhte sich, während sich die Schwermetalle Blei und Cadmium signifikant verringerten. Die oben genannten Ergebnisse zeigen den positiven Einfluss einer Nahrungsmittelergänzung mit Magnesium auf die Verringerung der Blei- und Cadmiummengen im Haar bei den untersuchten Personen.

*Kozielec T, Salacka A, Karakiewicz B., The influence of magnesium supplementation on concentrations of chosen bioelements and toxic metals in adult human hair. Magnesium and chosen bioelements in hair., Magnes Res. 2004 Sep;17(3):183-8.*

Die Analyse zeigte, dass die Konzentrationen von Ca, Fe und Zn im Haar die Auswirkungen der Nahrungsmittelergänzung widerspiegelten.

*Leung PL, Huang HM, Sun DZ, Zhu MG., Hair concentrations of calcium, iron, and zinc in pregnant women and effects of supplementation., Biol Trace Elem Res. 1999 Sep;69(3):269-82.*

Eines dieser Verfahren, welches zumindest für die Bestimmung der Aufnahme von Spurenelementen über die Nahrung großes Potenzial gezeigt hat.... ist die Verwendung von Haar als biologische Probe. Ein möglicherweise noch wichtigerer Vorteil könnte sein, dass Haar aufgrund der Beschaffenheit der Probe einen langfristigen Ernährungszustand statt nur die kürzlich aufgenommene Nahrung (d. h. vorherige Mahlzeit oder Vortag) widerspiegelt.

*Sauberlich, H. E.; Scala, J. H. Department of Nutrition, Letterman Army Institute of Research, San Francisco, California. Dowdy, R. P. Department of Human Nutrition, Foods, and Food Systems Management, University of Missouri, Columbia, Missouri*

Haar kann eine lückenlose Aufzeichnung des Ernährungsstatus liefern.

*Maugh, T. H. Hair: A Diagnostic Tool to Complement Blood Serum and Urine. Science1978; 202.*

Es wurde eine positive Korrelation zwischen dem Selengehalt in Nabelschnur-Blutproben und dem Haar von Neugeborenen festgestellt. Darüber hinaus wurde eine Korrelation zwischen Gebärmutter- und Nabelschnurblut sowie zwischen Nabelschnurblut und mütterlichem Blut festgestellt.

*Selenium Levels in Related Biological Samples: Human Placenta, Maternal and Umbilical Cord Blood, Hair and Nails. Lorenzo, A, et al. J. Trace Elem. Med. Biol. 19,1, 2005.*

Änderungen der Eisenkonzentrationen im Haar gingen einher mit vergleichbaren Änderungen der Konzentrationen der Marker, die am häufigsten zur Diagnose und Überwachung von Eisenmangel verwendet werden. Die Ergebnisse lassen vermuten, dass die Quantifizierung des Eisens im Haar bei der Bewertung des Eisenstatus im Körper nützlich sein könnte.

*Bisse E, Renner F, Sussmann S, Scholmerich J, Wieland H., Hair iron content: possible marker to complement monitoring therapy of iron deficiency in patients with chronic inflammatory bowel diseases?, Clin Chem. 1996 Aug;42(8 Pt 1):1270-4.*

Die Calciumkonzentration stand in Verbindung mit dem Risiko von KHK auf Populationsbasis und wies einen starken Zusammenhang mit der Wasserhärte der Wasserversorgung und den jährlichen Sonnenstunden auf, welche darüber hinaus unabhängig die SMR für KHK beeinflussten.

*MacPherson A, Bacso J., Relationship of hair calcium concentration to incidence of coronary heart disease., Sci Total Environ. 2000 Jun 8;255(1-3):11-9.*

In dieser Studie wurden die Calcium- und Magnesiumwerte von Patienten mit diagnostizierter Fibromyalgie im Vergleich zu einer entsprechenden Kontrollgruppe untersucht. Die Ergebnisse zeigten in der betroffenen Gruppe signifikant höhere Calcium- und Magnesiumwerte im Haar. Wilcoxon-Rangsummentests zeigten, dass Patienten mit Fibromyalgie signifikant höhere Calcium- und Magnesiumwerte aufwiesen als die Patienten der Kontrollgruppe mit einem alpha von 0,025 bzw. 0,05.

*Ng SY., Hair calcium and magnesium levels in patients with fibromyalgia: a case center study., J Manipulative Physiol Ther. 1999 Nov-Dec;22(9):586-93.*

Die Zink- und Kupferkonzentrationen im Haar und Urin von Patienten, die aufgrund von Myokardinfarkt (MI) ins Krankenhaus eingeliefert wurden, wurden gemessen. Die Mineralstoffkonzentrationen wurden auch bei Nachkommen der Patienten gemessen und mit einer Kontrollgruppe verglichen. Die Studie lässt vermuten, dass bei MI-Patienten ein genetisch bedingtes Mineralstoffungleichgewicht in einem jüngeren Alter herangezogen werden kann, um die Anfälligkeit für Herzerkrankungen vor dem Auftreten und der Diagnose bei asymptomatischen Patienten vorherzusagen.

*Detection of Potentially Myocardial Infarction Susceptible Individuals in Indian Population: A Mathematical Model Based on Copper and Zinc Status. Taneja, SK, et al. Biol. Trace Elem. Res. 75, 2000.*

Es wurde geschlussfolgert, dass die Haarmetallanalyse bei Proben nahe der Kopfhaut durch externe Kontaminationsquellen nicht ernsthaft invalidiert wird.

*Cadmium, Copper, Lead and Zinc Concentration in Human Scalp and Pubic Hair. Wilhelm, M, et al. Instit, Toxicol. Univ. of Dussseldorf, W. Wermany. 199-206, Vol. 92, 1990.*

Frauen mit Nickel-Empfindlichkeit wiesen im Vergleich zur Kontrollgruppe signifikant höhere Mengen an Nickel in Nägeln, Haar und Plasma auf.

*Nickel in Nails, Hair and Plasma from Nickel-Hypersensitive Women. Gammelgaard, et al. Acta. Derm. Venereol. 417, Vol. 70, 1990.*

Hohe Mengen an Quecksilber im Haar können ein Risikofaktor für akute koronare Ereignisse, Herz-Kreislauf-Erkrankungen und KHK sein, welche sämtlich die Sterblichkeit von Männern mittleren Alters im östlichen Finnland erhöhen.

*Virtanen JK, Voutilainen S, Rissanen TH, Mursu J, Tuomainen TP, Korhonen MJ, Valkonen VP, Seppanen K, Laukkanen JA, Salonen JT., Mercury, fish oils, and risk of acute coronary events and cardiovascular disease, coronary heart disease, and all-cause mortality in men in eastern Finland., Arterioscler Thromb Vasc Biol. 2005 Jan;25(1):228-33. Epub 2004 Nov 11.*

Die elementare Analyse von Haar wird bei der Beurteilung des Ernährungsstatus immer beliebter.

*Katz, S. A. Professor of Chemistry, Rutgers University.: The Use of Hair as a Biopsy Material for Trace Elements in the Body. Am Lab 1979; Feb.*

In Bezug auf manche Faktoren (Alter, Geschlecht, Gesundheit, Arbeit usw.) ist die Ursache für die Änderung der Menge an Spurenelementen offensichtlich, während der Einfluss anderer Faktoren (Haarstruktur, Größe und Gewicht des Patienten usw.) unbekannt ist. Für eine effektive Auswertung, Gültigkeit und Anwendung der Ergebnisse von Haaranalysen müssen zum Zeitpunkt der Untersuchung unbedingt alle Faktoren berücksichtigt werden.

*Sukumar A., Factors influencing levels of trace elements in human hair., Rev Environ Contam Toxicol. 2002;175:47-78.*

Forschungsarbeiten stützen die Sichtweise, dass die Menge an Spurenelementen in Haar und Nägeln die Aufnahme durch den Körper widerspiegeln. Daher lässt sich schlussfolgern, dass Haar und Nägel geeignete Proben zur Beurteilung der Reserven des Körpers sind.

*Hopps, H. C.: The Biological Bases for Using Hair and Nail for Analysis of Trace Elements. Trace Substances In Environmental Health VIII. Hemphill, D.D., ed. University of Missouri, Columbia. 1974.*

Dieser Referenzbereich von Spurenelementen in den Mähnenhaaren von Rennpferden sollte zur Bewertung von Erkrankungen und des Ernährungsstatus in Pferdepraxen herangezogen werden.

*Asano R, Suzuki K, Otsuka T, Otsuka M, Sakurai H., Concentrations of toxic metals and essential minerals in the mane hair of healthy racing horses and their relation to age., J Vet Med Sci. 2002 Jul;64(7):607-10.*

Konzentrationen im Haar können nützliche Informationen über die langfristige Ernährung liefern.

*Casey, C. E.; Hambidge, K. M.: Trace Element Deficiencies in Man. Advances In Nutritional Research Vol.3. Draper, H. H., ed. Plenum Pub., 1980. Hambidge, K. M.; Walravens, P.A.: Trace Elements in Nutrition. Prac Ped 1974, 1:1*

Die Patienten wurden in drei Gruppen mit jeweils zehn Patienten eingeteilt. Eine Gruppe wurde zwei Jahre, eine Gruppe vier Jahre und eine Gruppe sechs Jahre nach Implantation einer Totalendoprothese des Hüftgelenks untersucht. Hohe Mengen an Titan und Aluminium wurden insbesondere in der nach sechs Jahren untersuchten Gruppe im Haar gefunden, während die Menge der drei Ionen im Blut und Urin nicht signifikant war.

*Trinchi V, Nobis M, Cecchele D., Emission spectrophotometric analysis of titanium, aluminum, and vanadium levels in the blood, urine, and hair of patients with total hip arthroplasties., Ital J Orthop Traumatol. 1992;18(3):331-9.*

Die Studie lässt hoffen, dass Selen im Haar zur Überwachung niedriger Selen-Expositionen am Arbeitsplatz verwendet werden kann.

*Srivastava AK, Gupta BN, Bihari V, Gaur JS, Mathur N., Hair selenium as a monitoring tool for occupational exposures in relation to clinical profile., J Toxicol Environ Health. 1997 Aug 8;51(5):437-45.*

Die Ergebnisse des Qualitätssicherungsprogramms, welches 31 Teilnehmer auf vier Kontinenten umfasste, wurden beschrieben. Von den teilnehmenden Laboren halten 92 % konstant die QS/QK-Leistungsgrenzen für die Bestimmung von Hg im menschlichen Haar ein.

*Gill US, Schwartz HM, Bigras L., Results of multiyear international interlaboratory comparison program for mercury in human hair., Arch Environ Contam Toxicol. 2002 Nov;43(4):466-72.*

Die Konzentrationen von Ca, Fe, Cu und Zn im Haar waren in den drei Gruppen von Schwangeren niedriger oder signifikant niedriger als in den Kontrollgruppen. In den Seren waren die Unterschiede in den meisten Fällen nicht statistisch signifikant.

*Huang HM, Leung PL, Sun DZ, Zhu MG., Hair and serum calcium, iron, copper, and zinc levels during normal pregnancy at three trimesters., Biol Trace Elem Res. 1999 Aug;69(2):111-20.*

Es gibt heute umfangreiche Literatur über die Verwendung von Haar in der Forensik, bei der Diagnose von Krankheitszuständen und Bewertung des Ernährungsstatus.

*Stevens, B. J.: Determination of Aluminum, Copper, and Zinc in Human Hair. Atomic Spectroscopy 1983; 4:45*

Die Ergebnisse zeigten, dass die Kupferkonzentrationen im Haar insofern mit dem Schweregrad korrelieren könnten, dass bei höherer Kupferbelastung ein schwererer Autismus vorliegt. Die Mengen an Blei und Quecksilber waren bei der betroffenen Gruppe ebenfalls erhöht und stiegen abhängig vom Schweregrad an. Die Selen- und Magnesiumwerte unterschieden sich signifikant in der niedrigfunktionalen Gruppe von Kindern im Vergleich zu anderen Kindern der betroffenen Gruppe sowie der Kontrollgruppe.

*Priya, L, Geetha, A. Level of Trace Elements (Copper, Zinc, Magnesium and Selenium) and Toxic Elements (Lead and Mercury) in the Hair and Nail of Children with Autism. Biol.Trace Elem.Res. 2010.*

hTMA ist ein guter Indikator für die Exposition gegenüber Uran. Ohne diese Tests wären viele Menschen unbewusst nicht nur Schwermetallen wie Uran und anderen Metallen sondern auch Radongas ausgesetzt worden.

*Kehagia, K, et al. Hair Analysis as an Indicator of Exposure to Uranium. Radial.Prot. Dosimetry. Nov. 2010.*

Es wurde gezeigt, dass sowohl ein Mangel als auch ein Übermaß an Spurenelementen die Pathogenese von Schilddrüsenerkrankungen fördern.

*Hair Trace Elements in Patients with Goiter. Farkhutdinova, LM, et al. Klin Lab Diagn. Aug. (8) 2006.*

Ein Ungleichgewicht der Spurenelemente kann die biologischen Prozesse beeinträchtigen und steht im Zusammenhang mit vielen Krankheitsprozessen.

*Rahman, A. et al. Zinc, Manganese, Calcium, Copper and Cadmium Level in Scalp Hair Samples of Schizophrenic Patients. Biol.Trace Elem. Res. 127,2, 2009.*

Im Rahmen des metabolischen Syndroms könnten die optimalen Calcium- und Magnesiumkonzentrationen ein vermindertes Risiko für das metabolische Syndrom widerspiegeln.

*Hair Tissue Mineral Analysis and Metabolic Syndrome. Park, SB, et al. Biol.Trace Elem.Res. 130,3, 2009.*

Die Forschungsergebnisse lassen vermuten, dass manche Mineralstoffe wie Arsen, Selen und wahrscheinlich Iod, Zink, Natrium und Vanadium zur Regulierung von Krebs beitragen und dass eine Metallom-Studie unter Verwendung mehrfacher logistischer Regressionsanalyse ein nützliches Hilfsmittel zur Bestimmung des Krebsrisikos ist.

*Metallomics Study Using Hair Mineral Analysis and Multiple Logistic Regression Analysis: Relationship Between Cancer and Minerals. Yasuda, H, et al. Environ. Health Prev.Med. 24,5, 2009.*

Es wird mehr und mehr anerkannt, dass Schwermetalle als Mediatoren bzw. Faktoren bei der Entwicklung oder Progression von Herz-Kreislauf-Erkrankungen fungieren und dass ein Mangel, fehlende homöostatische Kontrolle oder eine übermäßige Einnahme mancher Metalle die Sterblichkeit im Zusammenhang mit Herz-Kreislauf-Erkrankungen steigern kann.

*Afridi, HI., et al. Evaluation of Toxic Elements in Scalp Hair Samples of Myocardial Infarction Patients at Different Stages as Related to Controls. Biol. Trace Elem. Res.134, 1, 2010.*

Es wurde festgestellt, dass zwischen den Bleimengen im Haar und im Körper eine solide Korrelation besteht.

*Black AP, Knight R, Batty J, Haswell SJ, Lindow SW., An analysis of maternal and fetal hair lead levels., BJOG. 2002 Nov;109(11):1295-7.*

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