



High hair selenium mother to fetus transfer after the Brazil nuts consumption



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ABSTRACT

Lactating mother and her two month old healthy daughter (APGAR 10) gave their scalp hair for a multi-element profile analysis; 25 elements were analyzed with the ICP MS. Mother's hair was divided into 5 cm long segment proximal to the scull (*Young*), and the distal segment further up to the hair tip (*Old*). One centimeter of hair records one month of the metabolic activity of the bioelements in the body. Mother's *Young* hair and daughters hair have 2.70 and 9.74 $\mu\text{g g}^{-1}$ Se, a distinctly higher Se concentrations than the *Old* hair of 0.87 $\mu\text{g g}^{-1}$. The adequate hair Se concentrations in Croatia women population vary from 0.08 to 0.63 $\mu\text{g g}^{-1}$; values below or above that range indicate deficiency or excess, respectively. Dietary recall revealed that during the last trimester of pregnancy and over a period of a week, the mother has consumed 135 g of Brazil nuts (*Bertholletia excelsa*) (BN); BN is an exceptionally rich Se dietary source. The amount of Se in BN varies and one week consumption of 135 g of BN may result in Se daily intake of 367 to 492 $\mu\text{g g}^{-1} \text{ day}^{-1}$ over a period of seven consecutive days, and what is about or exceeds the Upper Limit of daily selenium intake of 400 $\mu\text{g g}^{-1} \text{ g}^{-1}$. The excessively high infant hair Se mirrored a natural high mother to fetus transplacental transfer of bio elements in the last trimester of pregnancy. The potential toxicological risks of such a high Se transfer remains to be elucidated.

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1. Introduction

Selenium is an essential trace element indispensable for life [1]. The daily selenium requirements are well defined for adult persons, however, infant selenium requirements are the subject of expert consensus based on selenium in milk concentrations [2,3].

This paper is about an unusual observation which caught our attention. Lactating mother and her two months old breastfed baby gave their hair for a multi-element profile analysis. Mother's scalp hair proximal to the skull, *i.e.*, *Young* hair, contained three times more selenium than the distal part of the same hair sample (*Old* hair); also her two months old daughter has even the higher excessive hair Se. Evidently, substantial amounts of dietary selenium may

be transferred *via* placenta from mother to fetus hair during pregnancy. This observation initiated our thorough dietary history recall of mother's nutrition with the aim to elucidate this unusual finding along the same thread of hair.

2. Subject (mother and daughter)

On April 12, 2014 a young 30-year old healthy white Caucasian woman (♀SB, 63 kg, 175 cm), Zagreb, Croatia, gave a natural birth to her healthy first baby daughter (♀KBM, birth weight 2670 g, birth length 46 cm, APGAR 10). Two months later, both mother and daughter gave their hair for hair multi-element profile analysis; the informed consent was given by the mother. Mother's long hair has been divided into two parts: (A-Proximal, *Young*) some 5 cm up from the protuberantia occipitalis externa on the skull, and (B-Distal, *Old*) involving the rest of the hair up to the hair tips. Thus, Part A represents the younger hair whereas the Part B represents the older hair. Twenty-five elements were analyzed with the ICP-MS in every hair sample (the essential elements are

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potential role of Brazil nuts for human selenium supplementation also has been recognized [16–18].

Hair is growing at approximately 1 cm per month [19,20] so that the 5 cm long segment of mother's (Ms. ♀SB) hair, would cover the time period from the third trimester of pregnancy till the end of the second month of lactation. According to this data of hair growth, the inadvertent exposure occurred in the last trimester of pregnancy and this event could be followed in the early lactation. Evidently, the mother can get her selenium from the diet whereas the fetus and breastfed infant can get it only from the mother.

For the first time, to our knowledge, it became possible to see what was an *in vivo* bioelement metabolism at the late stage of pregnancy and early stage of lactation. It should be noted that the absorption of many bioelements is also increased during the late stages of pregnancy. Indeed, infant period of life is characterized by substantially higher absorption of elements than it is later in the adult life [21]. Ward and Ward also found scalp hair selenium concentrations to be increased in children (Mean, Range; 1.18, 0.31–1.98 $\mu\text{g g}^{-1}$) and what is still far below the hair selenium of here reported infant hair selenium of 9.74 $\mu\text{g g}^{-1}$ [22].

Evidently, high pregnancy (third trimester) put a high toll upon mother to provide her baby with all the essential nutrients. All the elements in mother's hair, except boron and phosphorus, appeared to be increased after the termination of pregnancy, indicating that the fetal body growth put huge metabolic demands upon the mother's body in the later two months of lactation when the infant girl ♀KBM was exclusively breastfed (Table 1). The excessively high values of mother hair calcium are likely to indicate the massive calcium transfer from mother to infant by placenta and later by the mammary gland. The results showed that mother's iron status was low in both pregnancy and lactation, and it is unknown if such an imbalance may have an effect on other element transfers from mother to the fetus. Our results corroborate with the traditional pediatrician views that baby nutritional needs have a precedence over the mother's body nutritional requirements [23]. Indeed, hair iron concentrations in the infant were in the observed normal adult iron range whereas those of the mother were definitively low (see Table 1 for reference values). Also, this infant has a much better iodine status than her mother [10]. Although the mother was receiving Se at about Upper Limit (on average) of selenium day after day for seven consecutive days, a healthy infant of low birth weight [24] was born.

4. Conclusion

The hair multielement profile analysis has passed a long way to get established as a reliable and reproducible analytical tool [25–27]. The here presented results of a naturally occurring experiment provides an insight in selenium metabolism in pregnancy, lactation, and neonatal periods of life. Very high amounts of Se were absorbed by the pregnant mother and transferred via placenta into the infant. Hair multielement profile analysis offers a new possibility for the study of the trace element metabolism in gestation, lactation and the infant periods of life in a non-invasive way and in full compliance with the current ethical considerations [28]. Indeed, we suggest that the metabolism of bioelements need to be studied in their mutual and contextual relationships and not in isolation. Also, here presented data may be considered as an invitation for necessary future research and validation.

Conflict of interest

The authors declare no conflict of interest.

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Appendix A. Supplementary data

Supplementary data associated with this article can be found, in the online version, at <http://dx.doi.org/10.1016/j.jtemb.2015.10.004>.

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