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THE STRUCTURE OF HAIR THICKNESS DISTRIBUTION OVER WOMEN'S HEADS SURFACE

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SUMMARY

The article encompasses a possible concept of description of the structure of hair thickness distribution over women's heads. It is based on real data realized in Caucasian population and results in the necessity of introduction of several type groups of women's heads coverage. With an example included, it eliminates the possibility of the distribution to be random and that there are all of the possibilities of the distribution realized in the population, as well as that it could be reasonable to average these distinct type groups and look for the mean distribution in the population. The distribution structure is most likely contingent on genetics and is entrenched in some part of the DNA; it is not yet clear however, what intra-species advantages particular structure types could yield, while the correlation of the particular distributions with types of humans is subject to current research.

Key words: human hair, diameter, capillitium

INTRODUCTION

There exists quite a number of works dealing with human hair diameters in dependence on the ethnic group or the age of the individuals. Only few of these works take into account the individuals' sex and, with a few exceptions, they don't mention from which part of the head surface the hair had been taken. Just in several works the authors refer to the sample taking place and they try to keep it constant for the whole set under investigation. Nevertheless, a work dealing consistently with the types of hair growth on the human heads at least as to the hair diameters is still missing. The only exceptions are the works on the men's baldness types. For our work, we have picked only women's samples, to avoid excessive spread of the values due to men's baldness in some areas of the head surface. The original intent had been to find a single map of hair thickness on the women's head surface. As it turned out, it has been necessary to introduce several such maps, for to the results to give consistent evidence.

Hair

Human hair is a fibre, whose physical appearance and mechanical strength is influenced by a number of factors, including ethnic origin, hygiene, chemical treatment or environment (Zhenxing et al., 2009). Despite of large number of studies, however, its structure is not fully identified. The middle part of the hair (i.e. the hair shaft) consists of three concentric layers: the cuticle, the cortex and the medulla. Each of these components has different structure and function. The cuticle protects the inner parts from the outer environment and from derogation caused by daily treatment. The cortex (90 % of the hair) determines mechanical properties of the hair, and the medulla can sometimes be completely absent (Benzarti et al., 2011).

Differences among hair

Most common interest in hair is focused on hair growth, hair types and hair care, but hair can also be looked at as an important biomaterial, that can vary depending on the ethnic ancestry or the age (Benzarti et al., 2011). The character of the hair is constantly changing from prenatal development up to the old age and one and the same follicle produces successively different types of hair, even in physiological conditions. In some children at the age of two to three years the hair type and colour change can be remarkably rapid (Bartošová et al., 1982). Children's hair is finer on the average, round and often less medullated and more light-coloured then the adults' hair. The cuticle vs. cortex ratio is less dependent on the age, but the information about the chemical and physical properties is missing. Limited experimental data show that children's hair is more transparent with tendency to higher clearness (Bogaty, 1969). In teen-agers at the beginning of puberty, the change of the hair character and distribution is most prominent. Terminal hair, that occurs in various localisations at that time and replaces the intermediate type of capillitium or the fine vellus on the body surface, is relatively long, well pigmented and contain medulla either fragmented or in the whole stem length. The coarse capillitium hair of adolescent boys is more medullated then the finer girls' hair in most cases (Bartošová et al., 1982).

The work (Hay et al., 2011) addresses the differences between pigmented and non-pigmented (grey) hair. It states that grey hair is more firm, wire-like. Kaplan et al. (2011) states in his work that the differences between pigmented and non-pigmented hair need not hold in general, what applies for one person that its hair is significantly thicker, need not apply for another person. Decrease of the hair volume on the head surface, and also drop of the hair diameter, is not only reflection of aging, but also reflection of some internal change in the hair itself (Mamada et al., 2007).

OBJECTIVE

The aim of this work has been to map the hair diameters in preselected areas of women's heads.

Some foreign studies address this point, but the authors fail to mention the exact place of the hair taking. That's why we specified the given taking places, where the particular hair diameters could differ

METHODS

We have been taking by five samples from five different areas of the head surface. These areas have been denoted by letters of alphabet: A – left temple, B – the place above the forehead centre, C – right temple, D – vertex, E – occiput. Each woman had filled a questionnaire before the taking containing 16 questions. The questions recorded basic anthropological data as body mass, height, age, eye and hair colour. Further they involved the lifestyle of the woman (e.g. vegetarianism, veganism …), hair dyeing, smoking, use of pharmaceuticals, contraception, substances containing caffeine or theine. We have also asked about place of residence and employment field.

The hair has been cut with sharp scissors close to the head and immediately put in a labelled polythene bag with zip fastener. This way they have been stored and later processed.

Each hair has been put in an optical microscope equipped with a camera connected to a computer (fig. 1). Using the TSView program, the diameters have been measured (fig. 2) in four distinct places along its length with fivefold repetition. From the diameters obtained this way, one average diameter for a particular hair has been calculated. For each sample taking place three hairs have been measured this way.
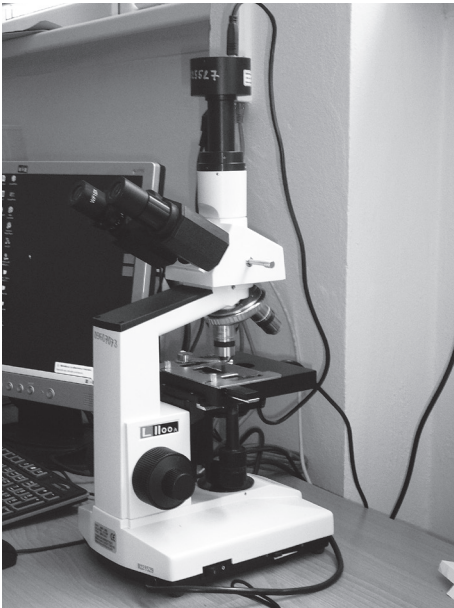

Figure 2. Picture of the hair taken with the optical microscope connected to the computer.

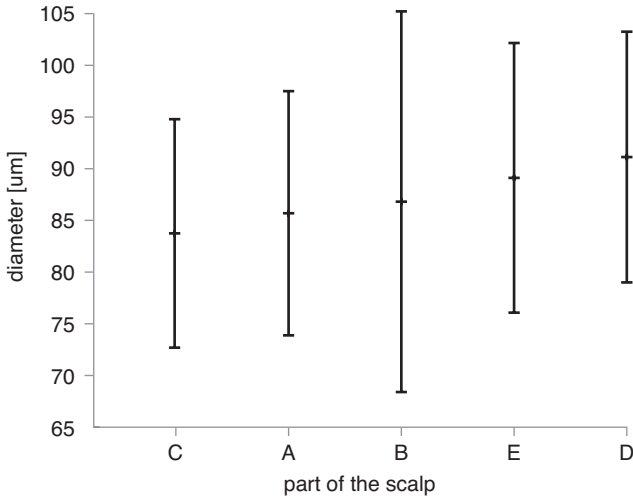**Figure 1.** Optical microscope with a camera connected to the computer.

Diagram 1. Particular head surface areas sorted by mean hair diameters on all researched heads. With the mean values standard deviations of the measured hair sets are also marked.
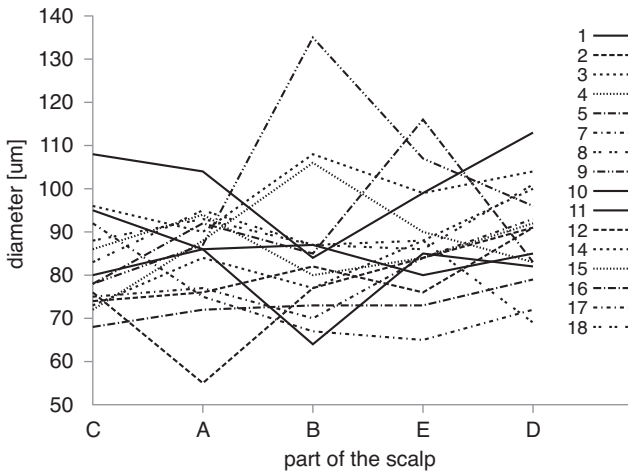

Diagram 2. An example of the hair diameter mean values of randomly selected 16 women.
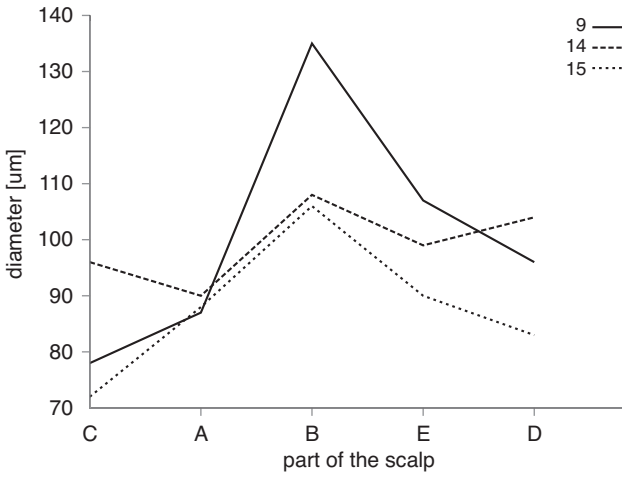
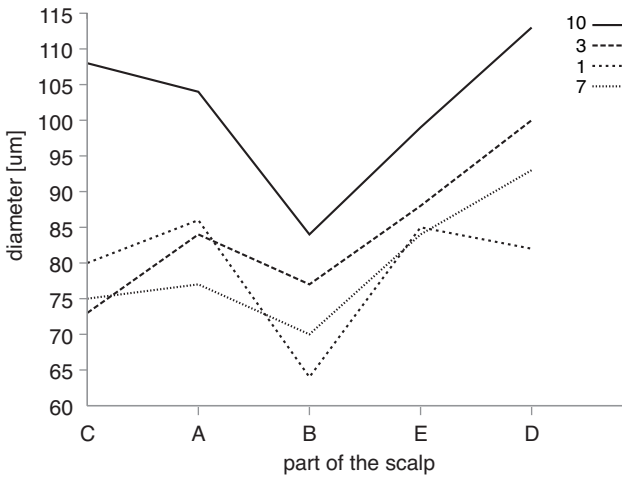**Diagram 3a.** First selected group of women with similar hair thickness distribution.

Diagram 3b. Second type group of women with similar hair thickness distribution on their heads.

Table 1. The particular areas of the head sorted by mean hair diametres. So the DBCEA code means e.g. that the woman No. 8 had the most thin hair in the D area and the most thick in the area labelled A.

Number of women	Code structures
12	ACBED
14	ACEDB
7	BCAED
1	BCDEA
10	BEACD
4	BECDA
9	CADEB
2	CAEBD
16	CAEBD
3	CBAED
15	CDAEB
5	CDBAE
18	CEBAD
8	DBCEA
17	EBDAC
11	EDABC

A – left temple, B – the place above the forehead centre, C – right temple, D – vertex, E – occiput

a

b

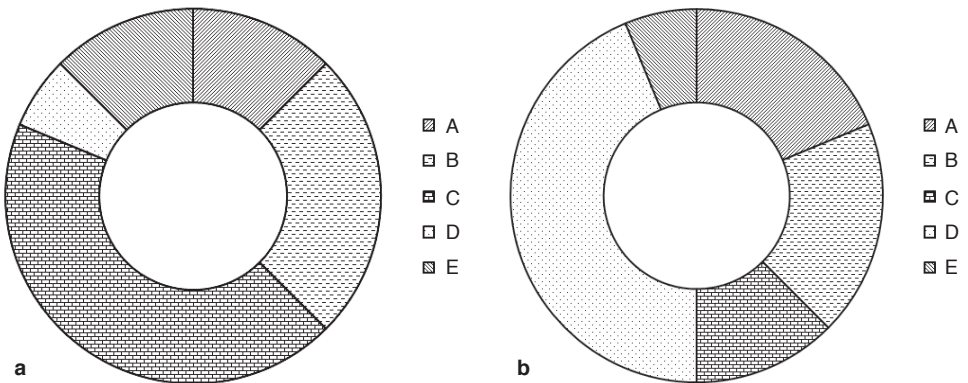|	
▨	A
▣	B
⊞	C
▢	D
▨	E

Diagram 4a, b. Diagram a records the number of frequent occurrence of the most thin hair within the frame of the head surface in particular investigated areas. Diagram b – the area with the thickest hair. While the area with thin hair is often represented by the C area, among the typical areas with the highest hair diameter most often falls the D area. By contrast, the thinnest hair on the head seldom occurs in the D area, and the thickest in the E area.

DISCUSSION AND CONCLUSION

First thing to come to our mind when attempting to find a distribution scheme is to sort the investigated areas e.g. in ascending order and calculate standard deviations in particular areas. The result can be seen in Diagram 1. When we display the mean values for some randomly selected women (Diagram 2) we can suspect a break-up into several groups, as the curve shape remains similar for whole groups of the women researched, see Diagrams 3a, b.

When we sort the particular areas by increasing mean diameters, we get five-letter codes for particular women, example of which is in Table 1. As can be seen, the code structures arising in the example are far from random ones. They do not e.g. tend at all to realizing all permutation alternatives and not by a long sight evenly. In Diagram 4a, b, we can see per cent representation of particular head areas, both with the thinnest hair and by contrast the areas where the hair has maximum diameter. The C area occurs in the whole of 69% cases in the first two places of the code (so it contains either the thinnest hairs, or the second most thin), while in case of random distribution the probability would be only 40%. Areas A and C often occur side by side, in 50% women (when random would give 25%). There is an interesting phenomenon when the thinnest hairs are contained in the E group. This area is often in some way reciprocal to the most frequent distribution and always! ends with the C area, that, as we have said, mostly starts the sequence.

Detailed investigation of hair thicknesses in the particular areas of women's heads has shown, that there doesn't exist a single structure of distribution of these diametres, but it is necessary to introduce several of these structures right away. Between these structures there are most likely no smooth transitions, hence their genetic conditionality seems to be probable. We consider proven the existence of groups CXXXD, a small but rigid group with at most one permutation EBDAC and the BXXXY group where Y means the A or D area, and X the remaining ones. The affinity of the curve shapes as in Diagram 3a, b gives the CXXXB group and confirms the BXXXY one. After obtaining more data, we are planning to perform cluster analysis of the diameters and to evaluate the frequency of all permutation groups.

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STRUKTURA ROZLOŽENÍ TLOUŠTĚK VLASŮ NA POVRCHU ŽENSKÉ HLAVY

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SOUHRN

Článek obsahuje návrh možnosti, jak popisovat strukturu rozložení tlouštěk vlasů na ženské hlavě. Vychází z reálných dat zjištěných u bělošské populace a dochází k nutnosti zavedení několika typových skupin pokrytí ženských hlav. Na příkladu vylučuje možnost, že je rozdělení náhodné a že jsou v populaci realizovány všechny možnosti rozložení, stejně tak, že by mělo smysl tyto celkově typově rozličné skupiny vzájemně průměrovat a hledat střední populační rozložení. Struktura rozložení je nejspíše podmíněna geneticky a je pevně zakotvena v nějaké části DNA, jaké však jednotlivé typy struktur poskytují vnitrodruhové výhody, není zatím známo, zatímco s jakými typy lidí jednotlivá rozložení korelují, je předmětem současného výzkumu.

Klíčová slova: lidské vlasy, průměr, kapilicium

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