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HARRIS'S LINES VERSUS CHILDREN'S LIVING CONDITIONS IN MEDIEVAL WROCŁAW, POLAND

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Abstract: The skeletal material used for research included osseous remains of 28 individuals, infantile and adolescent (inf. I, inf. II, juv.) from two medieval Wrocław cemeteries. The analysis attempted to evaluate the occurrence of Harris's lines on 33 femoral bones and 32 tibial bones. We found that the number and condensation of the lines were different and were not related to the individuals' age. Harris's lines were present in most of the examined individuals with the exception of newborns. The occurrence of Harris's lines in the examined material might confirm difficult living and hygienic conditions in medieval Wrocław.

Key words: *paleopathology*, *physiological stress*, *Harris's lines*, *medieval Wrocław*

Historical sources (among them Czerwiński 1979) state that in medieval Wrocław, in spite of significant political and economic development of the city, living and hygienic conditions were difficult which particularly influenced health and biological condition of children and young people. Therefore, we decided to evaluate some characteristics of the infantile skeletons from two series: cemetery in St. Jakub church (XIII–XV centuries) and from the cemetery in St. Krzysztof church (XV–XVI centuries).

The skeletal material is very scarce and includes the remains of 28 individuals; it was explored during the so called "rescue research" related to conservation works in both churches. Since it was the only available infantile skeletal material of this kind in Wrocław, we decided to analyse it in detail.

For this reason we have undertaken, among others, an attempt to evaluate occurrence of Harris's lines on long bones as one of the determinants of physiological stress.

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While examining osseous material of the fossil populations Wegner (1874) noticed that at the cross-section of the bones, in spongy tissue, there are visible lines of increased, unnatural density tissue. Those were the first observations of this condition, some time before invention of radiological technique. Interest in this problem grew with the use of radiology in the research. The first attempts of explanation of such a pathological picture of the bones were made. Initially, researchers explained their occurrence as bone growth disorders related to the kind of diet and leading to scar formation in the spongy tissue (Wells 1967). Examining fossil osseous material, Harris (1933) explained the formation of these lines in bones by their retarded growth. Since that time transverse lines are called Harris's lines.

Harris's lines were analysed most frequently while describing the health condition and diet of the population as one of the determinants of physiological stress in its broad meaning (Wells 1967). It was found that their formation is an individual response of the organism to its functional disorders (Dubos 1965). Consequently, it was acknowledged that transverse lines in long bones provide a lot of information regarding phenomena taking place in the individual as well as population development (Marshall 1968). Thus, research of Harris's lines contributed to our knowledge of organism reactions to adverse environmental conditions.

The analysis of the causes of transverse line formation both in contemporary and in fossil populations broadened a group of factors influencing the bone growth retardation. Steinbock et al. (1976) include here various inflammatory states, famine periods, deficiencies in food composition, intoxications and other disease factors. The mechanism of transverse line formation was described in detail at a later time by scientists conducting experiments on animals. The formation of Harris's lines was induced in the bones of animals fed with fodder lacking in protein and vitamin A (Nowak 1996).

Harris's lines can have various shape, thickness and course. Different definitions were presented in the history of transverse lines' research. Initially, they were defined as a single line of the length not shorter that 5 mm running from endosteum in the direction of the middle part of bone shaft (Gran et al. 1968). Clark (1978) thinks that the line should be visible in rentgenogram and spread at least to the half of bone shaft, and Goodman et al. (1981) believes that it should be characterised by a distinct contrast resulting from the increased densification of the bony substance of at least 1/4 of bone shaft width. However, as appears from

the observations of transverse lines, their picture is differentiated even within the same bone (Nowak 1996), which indicates that each of the above quoted definitions might be regarded as correct.

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Out of 28 examined infantile skeletons from the cemeteries in St. Jakub and St. Krzysztof churches in Wrocław, 21 had long bones whose condition allowed for making roentgen pictures (Fig. 1).

Fig. 1. Roentgenogram of tibial bones with visible Harris's lines

Table 1

Number and percentage of infantile skeletons in three age categories, from churches of St. Jakub and St. Krzysztof in Wrocław

Age category	Age (in years)	*N*	[%]
Infans I	0–3	6	29
	4–7	5	24
Infans II	8–11	4	19
	12–15	4	19
Juvenis	16–19	2	9
Total		21	100

The age of the examined individuals was determined basing on:

– dentition state according to Ubelaker scale (1989);

– stages of bone union formation of long bones epiphyses with their shafts according to various authors – after Piontek (1996);

– average lengths of long bones after Stloukal and Hanáková (1978).

It appeared that the age of the individuals is varied and oscillates between 0 and 19 years of age and includes three groups: infans I, infans II and juvenis. For the needs of the analysis we divided each of the groups into two classes comprising 3-year periods (Tab. 1).

To determine Harris's lines we used rentgenograms of femoral and tibial bones, analysing farther epiphyses of femoral bones as well as nearer and farther epiphyses of tibial bones. We assumed that if the lines occurred on at least one of these epiphyses, which frequently resulted from preservation condition of the bones, they were caused by physiological stress factors, leading to periodic arrest of the bones' longitudinal growth.

Harris's lines were present in 17 out of 21 examined individuals. We found out that the individuals without the lines belong to the youngest age group (from 0 to 3 years of age). All skeletons without Harris's lines were described as belonging to newborns.

Such a frequent occurrence of the lines in the examined material might be attributed to dietary deficiencies and poor hygienic conditions in the medieval city (Table 2).

Table 2

Number of infantile skeletons with Harris's lines

Age category	Age (in years)	*N*
Infans I	0–3	2
	4–7	5
Infans II	8–11	4
	12–15	4
Juvenis	16–19	2
Total		17

The number of Harris's lines in the vicinity of femoral and tibial bones epiphyses is varied and oscillates between 1 and 8. The greatest number of the lines (6–8) was present on the farther epiphyses of femoral bones. On the other hand, we did not find any relation of the lines' number to the individual's age.

The thickness and condensation of the lines were also diversified. Very thick lines were found in four individuals, which might testify to stronger and more prolonged stress. Thicker lines occurred in those individuals who also had more of them. The lines were spread at different intervals which might be related to a different frequency of stress occurrence and to the lines' resorption and individuals' age. We found that in the same individual the lines on the right and left bone occur at a similar height, and the differences between their numbers on both sides might be caused by resorption.

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Despite a small number of medieval infantile skeletons' series from Wrocław, we think that it is possible to formulate the following, very prudent conclusions:

1. The occurrence of Harris's lines in long bones of the majority of the examined infantile skeletons might testify to difficult living and hygienic conditions in medieval Wrocław. Historical sources confirm this. The presence of the lines might have been caused by such factors as: dietary deficiencies and childhood diseases.

2. Very scarce material does not allow for a more accurate analysis, however it is interesting to note that Harris's lines were absent in the long bones of newborns.

3. We did not find any relation between the Harris's lines' thickness and number, and the individuals' age.

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