Memoirs of the Scientific Sections of the Romanian Academy
Tome XLI, 2018

ANTHROPOLOGY

ABNORMALITIES AND PATHOLOGIES DISCOVERED IN THE SKELETAL SAMPLE FROM THE 16th–19th CENTURIES ARONEANU MONASTERY NECROPOLIS (IAŞI COUNTY, ROMANIA)

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This paper describes the frequency and anatomical abnormalities and pathologies identified on the skeletal sample discovered in 2014, in the Aroneanu Monastery Necropolis of Iaşi (Iaşi County, Romania). According to archaeological information, the necropolis was used since the first half of the 16th century until the beginning of the 19th century. The osteological material, consisting of 79 skeletons (children, adolescents, adults, matures and seniles), originated from inhumation tombs and reburials. The distribution by sex and age categories indicates a higher male frequency as opposed to females, resulting in a higher masculinity index. Most skeletons were recorded in the *maturus* category (59.49%), followed by *infans* I and II (21.52%), *adultus* (11.39%), *senilis* (5.06%) and *juvenis* (2.53%).

The abnormalities and pathologies were evaluated both separately, by sex, and for the entire sample. In the cranial segment (for the entire sample), the Wormian bones recorded the highest frequency (15.18%), followed by the metopic suture (3.79%), cranial trauma, *cribra orbitalia* (with equal incidence – 2.53%) and porotic hyperostosis (1.26%). In the postcranial segment, osteoarthritis is the most frequent (11.39%), followed by *spina bifida occulta*, sacralization and extra facets on the tibiotalar joint – with equal incidence (3.79%). Lower incidences were recorded for the supratrochlear foramen of the humerus and lumbarization (1.26% each). In the male series, the frequency of pathologies and abnormalities is higher compared to the female series. No pathologies and abnormalities were observed on the skeletons of children and adolescents.

Keywords: abnormalities and pathologies, necropolis, 16th–19th centuries, Aroneanu Monastery

1. INTRODUCTION

Bone abnormalities are defined as changes in normal anatomy, induced by disruptions of the chemical or metabolic functions under the influence of exogenous, genetic or teratogenic factors [14]. Bone anomalies can appear before or after birth and they range from less serious forms to major and sometimes lethal ones [3, 23]. Most frequently encountered in the human skeleton are bone fusion, ossification and underdevelopment anomalies and ageneses, all of them identified in numerous prehistoric and historic osteological samples around the world [43]. A great number of

congenital malformations can appear at the level of the skeleton, being localized on the skull, at the level of the spinal column and limbs. During prehistoric times, the congenital malformations were less frequently identified, as most of the affected children died shortly after birth or later, and their fragile skeletons did not survive in the taphonomic process [3]. The non-metric features (also called epigenetic, discontinuous morphological or discrete traits), as forms of variations observed in bone anatomy, are hereditary to a certain extent, so that they can be used in researches concerning ancestral connections; however, their genetic foundation is unclear [7].

Paleopathology analyzes the origins of diseases, their spreading, dynamics, evolution and progress over long periods of time, as well as the way people adapted to changes in their environment [13, 26]. The pathological aspects are induced by the interaction between the genetic and non-genetic factors.

The archaeological diggings carried out in 2014 at the Aroneanu Monastery of Iaşi (Iaşi county, Romania) as part of a rehabilitation project of this historical monument, led to the discovery of a necropolis. According to the data provided by archaeologist Stela Cheptea and collaborators, the necropolis was used between the first half of the 16th century and the beginning of the 19th century. The Aroneanu Monastery, also known in medieval documents as the "Aron Vodă" Monastery, the "Sf. Nicolae" Monastery of Iaşi or the Greek Monastery of the Earthly "Sf. Nicolae", were built in 1594 by Aron Vodă in the north-eastern part of Iaşi. The greed of the Greek monks and the poor administration repeatedly led the monastery complex to ruins. Nowadays, from the old monastery complex, only the "Sf. Nicolae" church remained; restored in the year 1907, it became the parish church of the Aroneanu Village, known nowadays under this name [4].

The present study describes the frequency and anatomical pathologies and abnormalities identifed in the osteological sample exhumed from the necropolis of the Aroneanu Monastery in Iaşi.

2. MATERIALS AND METHOD

The analyzed osteological sample includes a total of 79 skeletons (originated from inhumation tombs and reburials) exhumed in 2014 from the medieval necropolis (16th–19th centuries) of the Aroneanu Monastery in Iaşi. In most cases, the precarious state of preservation, as well as skeletons' deterioration during excavations impeded a strict realization of all analysis stages. The bone fragments were subjected to morphoscopic analysis, in view of estimating skeleton's age and sex, and for evaluating the abnormalities and pathologies of the cranial and postcranial segments. The study of each skeleton was preceded by washing and dirt removal, after which the bone fragments were marked and reconditioned. In the estimation of age at death, we used the criteria recommended by the classic methodology, depending on the different stages of growth (children 0–14 years,

adolescents, adults, matures and seniles). In the case of children and adolescents, we considered: the eruption of the temporary and permanent teeth, tooth buds' stage of development, the long bones epiphyses welding with the associate diaphyses, etc. Thus, the estimation of age at death in the case of subjects under 20 years (children – *infans I, infans II* and adolescents – *juvenis*) was based on the methodology suggested by Fazekas and Kosa, Schaefer and collaborators, Ubelaker [12, 29, 34]. In the case of subjects over 20 years (20–*x* years), the features analyzed in the postcranial segment were: facies symphysialis and the sacro-iliac surface transformation degree, changes in the spongial tissue from the humeral and femoral epiphyses, certain involution phenomena observable in the skeleton, as well as the presence of specific pathological processes which can appear with age. In the cranial segment, we studied the cranial sutures level of obliteration and tooth abrasion.

Sex estimation for the subjects over 20 years was based on the methods and techniques recommended by Brothwell, Mays, Walrath and collaborators [6, 24, 39]. For sex estimation, we analyzed the common shape of the pelvis, the degree of sacrum curving, the greater sciatic notch degree of opening, the robustness of the long bones, as well as the forehead shape and degree of inclination, mandible robustness, teeth shape and size.

The cranial and postcranial abnormalities and pathologies were identified and analyzed according to the methods, criteria and techniques recommended by Mays, Kimmerle and Baraybar, Waldron, Ortner, Aufderheide and Rodriguez-Martin, Barnes [24, 18, 36, 25, 1, 3].

3. RESULTS AND DISCUSSIONS

Out of the 79 skeletons under analysis, 17 belonged to children (0–14 years), 2 to adolescents (14–20 years; one male and one female), 9 to adults (20–30 years; 4 males and 5 females), 47 to mature people (30–60 year-old; 36 males and 11 females) and only 4 to elderly ones (over 60, one male and 3 females).

It was found out that child skeleton frequency (*infans I* and *II*) reaches a percent value of approximately 22%, the highest rate being recorded among children aged between 0 and 7 years (about 15%). The frequency of adolescent skeletons is significantly lower (2.5%). For the 20–x year age group, the highest frequency is recorded among matures (59.5%), whereas the adults and the subjects over 60 are fewer (11% and 5%, respectively).

The frequency of abnormalities and pathologies in the osteological sample found in the necropolis of the Aroneanu Monastery in Iaşi (16th–19th centuries) is presented in Table 1. The values were calculated both for the two sexes (42 males and 20 females) and for the entire sample (79 subjects). Due to the precarious preservation of the subadult bones and to the fact that certain osteopathies become obvious later in life, no pathologies and abnormalies could be identified on the skeletons of children and adolescents.

A. CRANIAL ABNORMALITIES AND PATHOLOGIES

In the cranial skeletons of the entire osteological sample, we identified Wormian bones (15.18%), followed by metopic suture (3.79%), cranial trauma and *cribra orbitalia* (with equal frequency – 2.53%) and porotic hyperostosis (1.26%) (Table 1).

Table 1

Frequency of abnormalities and pathologies in the skeletal series exhumed from the necropolis of Aroneanu Monastery in Iași (16th–19th centuries)

Abnormalities*/ Pathologies**		**Males (14–*x* years)**		**Females (14–*x* years)**		**Children (0–14 years)**		**Total**	
		N	**(%)**	**N**	**(%)**	**N**	**(%)**	**N**	**(%)**
Cranial segment	Wormian bones*	9/42	21.42	3/20	15.00	–	–	12/79	15.18
	metopic suture*	2 /42	4.76	1/20	5.00	–	–	3/79	3.79
	cranial trauma**	2/42	4.76	–	–	–	–	2/79	2.53
	*cribra orbitalia***	2/42	4.76	–	–	–	–	2/79	2.53
	porotic hyperostosis**	1/42	2.38	–	–	–	–	1/79	1.26
	Total	17/42	–	5/20	–	–	–	22/79	
Post-cranial segment	osteoarthritis (Schmorl's nodules, osteophytes, bone erosion)**	8/42	19.04	1/20	5.00	–	–	9/79	11.39
	sacral *spina bifida occulta* (sacral occult spinal dysraphism)*	3/42	7.14	–	–	–	–	3/79	3.79
	sacralization*	3/42	7.14	–	–	–	–	3/79	3.79
	extra facets on the tibiotalar joint*	2/42	4.76	1/20	5.00	–	–	3/79	3.79
	supratrochlear foramen of the humerus*	–	–	1/20	5.00	–	–	1/79	1.26
	lumbarization*	–	–	1/20	5.00	–	–	1/79	1.26
	Total	16/42	–	4/20	–	–	–	20/79	–

Wormian bones. Also known as intersutural bones or Inca bones, they can be defined as small-sized formations of irregular shapes encountered in the cranial sutures. According to Bergman and collaborators [4], approximately 40% of the skulls have intersutural bones nearby the lambdoid suture or on the sagittal suture, close to the lambda point. The presence of sutural bones can be associated, in some situations, with other abnormalities of the central nervous system or skull [9].

In the skeletal sample unearthed from the necropolis of Aroneanu Monastery in Iasi, Wormian bones were identified in 12 subjects (9 males and 3 females – 15.18%) aged between 20 and 55 years. A special case was discovered in a male aged between 45 and 50 years (skeleton M3), who had a large Wormian bone (50 mm long and 28 mm wide) on the lambdoid suture (Fig. 1).

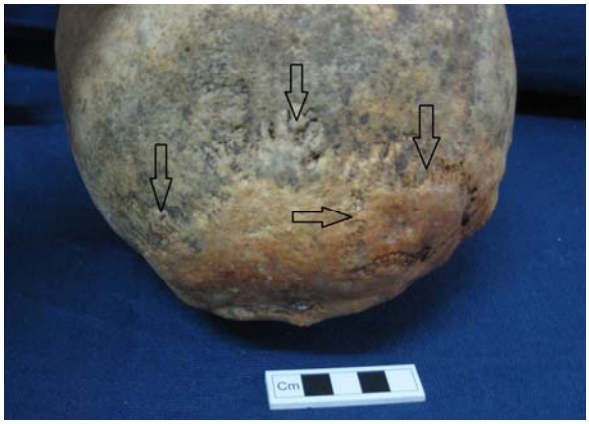


Fig. 1. Wormian bones within the lambdoid suture
(skeleton M3, ♂, 45–50 year-old)

Metopic suture is located between the frontal bones, from the anterior point of the anterior fontanelle to the glabella. The fusion of the metopic suture begins from the glabella, advancing progressively to the upper area and ending at the anterior fontanelle [41]. Ordinarily, this suture closes between the first and the second year of life and is completely closed before the subject reaches the age of three; however, it can sometimes stay open until the age of seven. There are also sporadic cases when the metopic suture remains open throughout life and it can be observed even in old people [15]. The persistent metopic suture can be ascribed to several causes, such as: abnormal growth of the cranial bones, pathologic metopism caused by hydrocephaly, growth interruption, heredospecific factors, heredity, atavism, etc. [8]. In the scholarly literature, the persistent metopic suture was reported with frequencies ranging between 1% and 12% of cases [30].

In the analyzed sample, the metopic suture was identifed in three subjects (2 males and one female – 3.79%) aged between 30 and 50 years (Figs. 2–4).

Cranial trauma. Trauma can be defined in many ways, in its conventional sense being a lesion of a living tissue caused by an extrinsic force or mechanism [32]. Although paleopathologists have made great progress in the interpretation of injuries found in ancient skeletal remains [19], violent behavior producing skeletal trauma is not always easily interpreted or understood from bioarchaeological records. Human skeletal remains provide direct evidence on lesions, such biological markers being useful in reconstituting the behaviors of ancient populations [37]. Interpretation of skull fractures is conditioned by a variety of features, including the bones involved, fracture appearance and malformation [17]. Generally, the most common fractures of the cranium affect the vault and are caused by direct trauma. According to Lovell, [21] they can be described by their basic type, usually linear, crush, or penetrating, which are not necessarily mutually exclusive.

In this skeletal sample, cranial trauma was identified in two males, adult subjects (aged between and 50–60 years) – 2.53% of the total population (Figs. 5, 6).

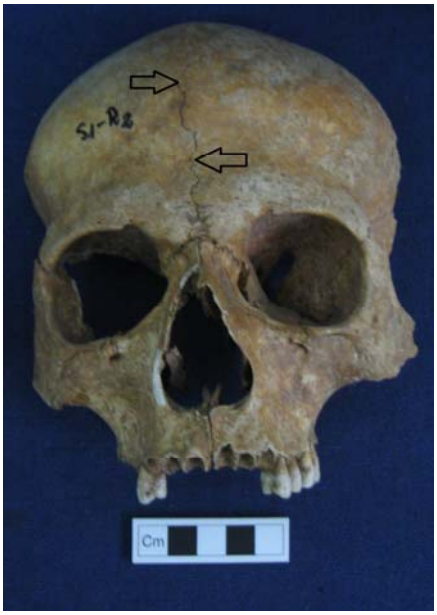


Fig. 2. Metopic suture in skeleton R2–S1, ♂, 30–35 year-old

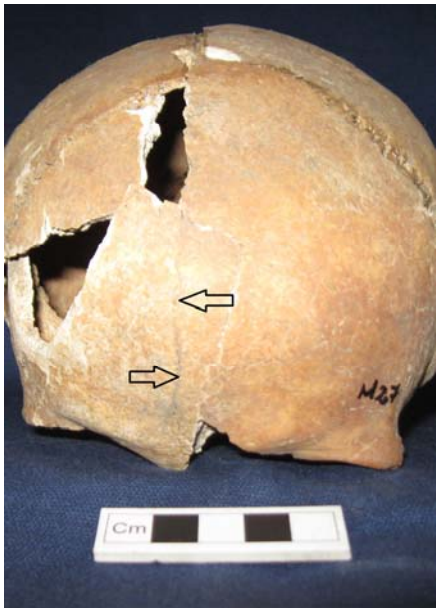


Fig. 3. Metopic suture in skeleton M27, ♂, 45–50 year-old

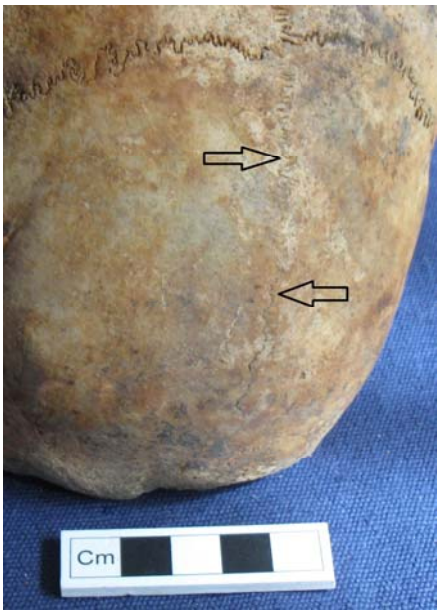


Fig. 4. Metopic suture in skeleton M10, ♀, 40–45 year-old

Fig. 5. Cranial trauma in the frontal bone (skeleton M8–A, ♂, 50–55 year-old)

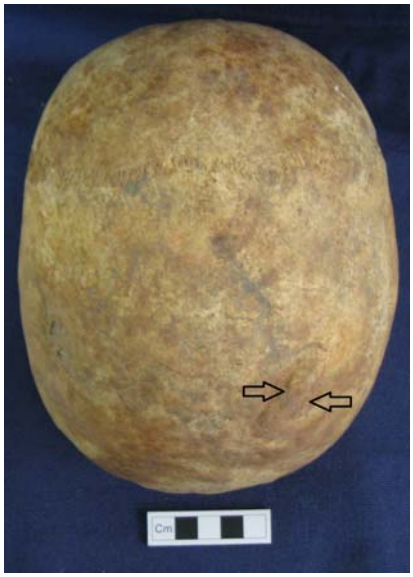


Fig. 6. Cranial trauma in the right parietal bone
(skeleton C–A3, ♂, 55–60 year-old)

Cribra orbitalia. The presence of this porosity (corrosion of the external compact layer of the orbital roof and thickening of the spongy bone layer) alludes to an iron deficiency in the organism, due to insufficient dietary intake of iron or to an environment laden with pathogenic agents [31]. In the absence of any additional proof to support this deficiency, experts recommend caution when establishing the final diagnosis of iron deficiency anemia. Thus, in the absence of exact diagnosis methods, other than simple morphoscopic examination, cribra orbitalia is a non-specific indicator of diseases [1, 40].

In the present study, cribra orbitalia was identified in two males, adult subjects (40–45 year-old and 50–55 year-old, respectively) – 2.53% of the total population (Figs. 7, 8).

Fig. 7. *Cribra orbitalia* in skeleton C2,
♂, 40–45 year-old

Fig. 8. *Cribra orbitalia* in skeleton
M17–A, ♂, 50–55 year-old

Porotic hyperostosis, also known as exocranial porosity or external *cribra cranii*, appears due to an abnormal increase in the bone tissue on the exocranium. The presence of porotic hyperostosis may suggest various diseases, such as: infantile scurvy, rickets, iron deficiency anemia, osteitis, osteomyelitis, periostitis, inflammatory processes of the cranial bones and skull or post-mortem osseous changes [25, 38]. Porotic hyperostosis is one of the most frequently studied indicators of subjects' state of health, also providing valuable information about the environmental conditions during their growth and development [35].

In this skeletal sample, porotic hyperostosis was identified in a single skull (1.26% of the total population), which belonged to a male aged cca. 50–55 years (Fig. 9).

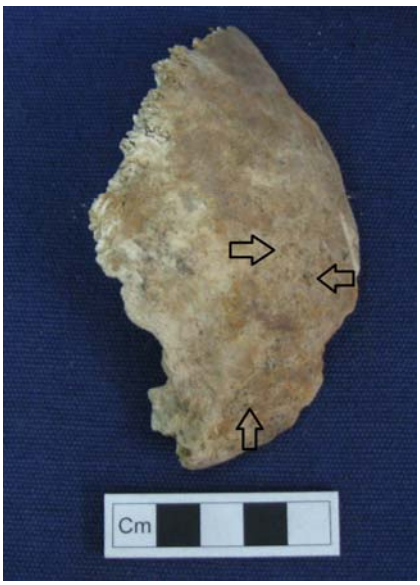


Fig. 9. Porotic hyperostosis in the frontal bone
(skeleton M17–A, ♂, 50–55 year-old)

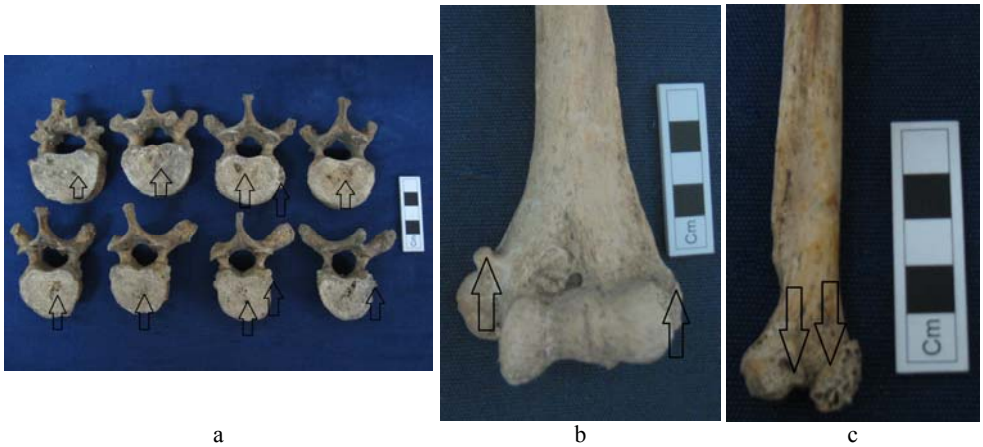
B. POSTCRANIAL ABNORMALITIES AND PATHOLOGIES

In the postcranial skeleton, the most frequent pathology recorded for the entire osteological series was osteoarthritis (11.39%) followed by *spina bifida occulta*, sacralization and extra facets on the tibiotalar joint with equal incidences (3.79%). Supratrochlear foramen of the humerus and lumbarization had lower incidence values (1.26% each) (Table 1).

Osteoarthritis is a degenerative joint disease caused by cartilage loss in a joint, producing lesions due to the direct contact between bones while, in the attempt to repair the lesion, joint's bone reacts by producing another bone [1]. Osteoarthritis generally affects the hip, hand, knee, lumbar and neck joints. We noticed that, after the age of 50, women are much more frequently affected by osteoarthritis in

comparison with men [20]. The cause determining osteoarthritis is yet unknown, however there are certain factors which amplify the risk of developing this disease, such as: heredity, overweight, joint lesions, repeated overstrain in certain joints, lack of physical activity, nervous lesions and aging. The study of a genealogical database concerning the population of Iceland revealed that hand osteoarthritis and hip osteoarthritis are strongly influenced by genetic inheritance, spreading over several generations [16].

In the analyzed skeletal sample, osteoarthritis was identified in 8 males (aged between 30 and 35 years) and one female of 30–35 years (11.39% of the total population), being mainly represented by osteophytes, Schmorl's nodules and bone porosity (corrosion). A case of multiple osteoarthritis was discovered in a male (skeleton M27, 45–50 year-old) (Fig. 10 a–c).



a b c

Fig. 10. Skeleton M27, ♂, 45–50 year-old: a. dorsal vertebrae with Schmorl's nodules and marginal osteophytes; b. right humerus – osteophytes in the inferior epiphysis; c. left cubitus – porosity (corrosion) and osteophytes in the inferior epiphysis

Sacral *spina bifida occulta* (occult spinal dysraphism). *Spina bifida* (spinal disraphism, spinal defect, neural tube defect) includes all forms of congenital spine abnormalities, resulting in a faulty neural arch which allows the meninx or neural elements to herniate [10]. The term *spina bifida* was first described by F. von Recklinghausen in 1882 [1]. Spinal dysraphism (*spina bifida*, spinal defect, defect of the neural tube, opened spinal column) includes all forms of congenital affections of the spinal column, resulting in a defect neuronal arch through which the meninx or the neuronal elements can protrude [10]. *Spina bifida* has multifactor origins, including a genetic predisposition and environmental factors; nevertheless, the exact cause remains unknown [42]. In the past decade, scientists observed that folic acid, zinc and selenium deficiencies in the maternal metabolism can lead to neural tube defects in the embryo. The three nutritional substances are necessary for the genetic control of cell growth during morphogenesis. *Spina bifida occulta* can affect any segment of the spine between the atlas and the sacrum; however, it is most frequently encountered in the lumbosacral area (L5–S1), with reported incidences up to 25% [3].

Sacral *spina bifida occulta* (sacral occult spinal dysraphism) was recorded in three subjects (3.79% of the total population), males aged between 25–50 years (Figs. 11–12).

Fig. 11. Total sacral *spina bifida occulta* in skeleton M25, ♂, 25–30 year-old

Fig. 12. *Spina bifida occulta* (S4–S5) in skeleton C3–A, ♂, 45–50 year-old

Fig. 13. Sacralization of the 5th lumbar vertebra in skeleton R2–S1, ♂, 30–35 year-old

Fig. 14. Incomplete lumbarization of the first sacral vertebra in skeleton M23, ♀, 30–35 year-old

Lumbarization and sacralization. A transitional lumbosacral vertebra is a common congenital anomaly first observed by Bertolotti. Lumbarization produces modifications at the level of the sacrum bone (the first sacral vertebra is separated from the sacrum – lumbarization of S1) [1]. The clinical significance of the lumbo-sacral transitional vertebra has been the subject of many debates, the number of cases ranging from 4% to 24% [11]. Sacralization of the 5th lumbar vertebra (L5) is a defect involving fusion of this vertebra with the sacrum bone, so that the lumbar spinal column loses a segment. The morphologic aspect of the sacrum bone is normal, however it presents an additional sacral foramen. On the contrary, if the first sacral segment is separated from the sacrum bone, this defect is called lumbarization S1. In both cases, the defect can be complete or incomplete, unilateral or bilateral, symmetric or asymmetric [1, 3].

In the studied skeletons, three cases of sacralization were identified (three males aged between 30 and 55 years – 3.79% of the total population) (Fig. 13), whereas an incomplete lumbarization was stated in a single case (female, 30–35 year-old – 1.26% of the total population, Fig. 14).

Extra facets on the tibiotalar joint are caused, according to some authors [33], by mechanical stress (the habit of squatting), whereas others [27] see it as a post-cranial epigenetic trait. The study of heredity revealed that the squatting facet can be seen on the tibia and talus during the fetal period and during childhood. With age, if squatting is no longer part of the daily routine, the associated facet disappears. Consequently, the main reason which determines the appearance of this facet is frequent squatting movements [2].

Extra facets on the inferior tibial epiphyses (11.39% of the total population), were identified in two male aged between 45 and 55 years (Fig. 15) and one female aged 40–45 years (Fig. 16).

Fig. 15. Extra facets on the tibiotalar joint in skeleton M27, ♂, 45–50 year-old

Fig. 16. Extra facets on the tibiotalar joint in skeleton M5–B, ♀, 40–45 year-old

Supratrochlear foramen of the humerus is considered by some authors [22] an atavism, whereas others [28] see it as a result of bone atrophy after ossification, induced by the mechanical pressure of the olecranon process over the supratrochlear area of the humerus, resulting in the atrophy of the olecranon process. In the studied series, the supratrochlear foramen of the humerus (olecranian perforation) was identified in a single female (1.26% of the total population) (Fig. 17).

Fig. 17. Supratrochlear foramen on the right humerus
in skeleton R1–B, ♀, 20–25 year-old

4. CONCLUSIONS

The osteological material analyzed in this study was exhumed in 2014 from the necropolis of the Aroneanu Monastery in Iaşi, by the archaeological team of the Centre for European History and Civilization of Iaşi. Archaeological excavations brought to light 79 human skeletons (16^{th} – 19^{th} centuries) originated from inhumation tombs and reburials.

Considering the entire sample, the main indicators of the state of health in the cranial skeletons are *cribra orbitalia* (2.53%) and porotic hyperostosis (1.26%). The presence of these pathologies is frequently used as an instrument to evaluate the state of health and the nutritional status of the past populations. Abnormalities such as Wormian bones (15.18%) and metopic suture (3.79%) identified in the cranial segment can be inherited, so that they can be used in studies concerning the

biological affinity of the human populations from the past. Cranial trauma was recorded in two male subjects (2.53% of the total sample).

In the post-cranial skeletons of the analyzed sample, osteoarthritis-related affections were identified in eight males (aged between 30 and 35 years) and one female aged 30–35 years (11.39% of the total population), being mainly located in the spine and on the joint surfaces of the appendicular bones. The main factors responsible for this affection are age and genetic predisposition; however, certain physical activities also play an important role.

The abnormalities identified in the post-cranial skeletons of this population were sacral *spina bifida occulta* (3.79%), sacralization (3.79%) and lumbarization (1.26%). The presence of extra facets on the tibiotalar joint (3.79%) and of supra-trochlear foramen on the humerus (1.26%) indicates that the subjects practised intense physical activities which strained their arms and also that they spent a lot of time in squatting position or in doing many repetitive genuflections.

An important observation regarding the skeleton is that the males appear more pathologically conditioned than the females. However, this conclusion has some limitations, due to the smaller number of female subjects in the analysed sample (sex ratio: 42/20). No abnormalities and pathologies were found out on the skeletons of children and adolescents.

Acknowledgements: We thank Dr. Stela Cheptea, archaeologist at the Centre for European History and Civilization in Iasi, for the osteological material made available for anthropological study.

Authors contributions: Vasilica-Monica Groza (first author) – 40%; Ozana-Maria Petraru (second author) – 30%, Bejenaru Luminița (corresponding author) – 30%.

REFERENCES

1. AUFDERHEIDE A.C., RODRIGUEZ-MARTIN C., *The Cambridge Encyclopedia of Human Paleopathology*, Cambridge: Cambridge University Press, 1998.
2. BAYKARA I., YILMAZ H., GÜLTEKIN T and GÜLEÇ E., *Squatting Facet: A Case Study Dilkaya and Van-Kalesi Populations in Eastern Turkey*, Collegium Antropologicum, 2010, **34** (4), 1257–1262.
3. BARNES E., *Developmental Defects of the Axial Skeleton in Paleopathology*, Boulder: University of Colorado Press, 1994.
4. BĂDĂRĂU D., CAPROŞU I., *Iaşii vechilor zidiri.* Demiurg, Iaşi, 2007, 152.
5. BERGMAN R.A., AFIFI A.K. and MIYAUCHI R., *Compendium of human anatomical variations*, Baltimore: Urban and Schwarzenberg, 1988, 197–205.
6. BROTHWELL D.R., *Digging up Bones*, Cornell University Press, London, 1981.
7. CARSON E.A., *Maximum – likelihood variance components analysis of heritabilities of cranial nonmetric traits*, Human Biology, 2006, **78** (4), 383–402.
8. CASTILHO S.M.A., ODA Y.J. and SANTANA G.D.M., *Metopism in adult skulls from southern Brazil*, International Journal of Morphology, 2006, **24** (1), 61–66.
9. DAS, S., SURI, R. and KAPUR, V., *Anatomical observations on os inca and associated cranial deformities*, Folia Morphologica, 2005, **64**, 118–121.
10. DAWSON F., *Spinal Dysraphism*, Medical Bulletin, 2006, **11** (12), 7–11.

11. DELPORT E.G., CUCUZZELLA T.R., KIM N., MARLEY J., PRUITT C. and DELPORT A.G., *Lumbosacral transitional vertebrae: incidence in a consecutive patient series*, Pain Physician 2006, **9**, 53–56.
12. FAZEKAS I.Gy., KOSA F., *Forensic Fetal Osteology*, Budapest Akademiai Kiado, 1978.
13. GŁADYKOWSKA-RZECZYCKA J.J., *Palaeopathology in Poland at the beginning of the 21st century*, Studies in Historical Anthropology, 2004–2006, **4**, 25–48.
14. GREGG J.B., GREGG P.S., *Dry Bone. Dakota Territory Reflected*, Sioux Printing, 1987.
15. IDE Y., INUKAI Y., YOSHIDA S. and SATO I., *The internal structure of bony tissue of a human metopic suture by Soft X-ray*, Okajimas Folia Anatomica Japonica, 2003, **79**, 169–173.
16. JÓNSSON H., MANOLESCU I., STEFANSSON S.E., INGVARSSON TH., JONSSON H.H., MANOLESCU A., GULCHER J. and STEFANSSON K., *The inheritance of hand osteoarthritis in Iceland*, Arthritis Rheumatism, 2003, **48**, 391–395.
17. KAUFMAN M.H., WHITAKER D. and MCTAVISH, J., *Differential diagnosis of holes in the calvarium: Application of modern clinical data to palaeopathology*, Journal of Archaeological Science, 1997, **24**, 193–218.
18. KIMMERLE E.H., BARAYBAR J.P., *Skeletal trauma. Identification of injuries resulting from human rights abuse and armed conflict*, Boca Raton: CRC Press, Florida, 2008.
19. LARSEN C.S., *Bioarchaeology: Interpreting behavior from the human skeleton*, New York, Cambridge University Press, 1997, 65–82/109–154.
20. LAWRENCE R.C., FELSON D.T., HELMICK C.G., ARNOLD L.M., CHOI H., DEYO R.A., GABRIEl S., HIRSCH R., HOCHBERG M.C., HUNDER G.G., JORDAN J.M., KATZ J.N., MARADIT KREMERS H. and WOLFE F., *National Arthritis Data Workgroup. Estimates of the prevalence of arthritis and other rheumatic conditions in the United States*, Part II, Arthritis and Rheumatism, 2008, **58** (1), 26–35.
21. LOVELL N.C., *Trauma Analysis in Paleopathology*, Yearbook of Physical Anthropology, 1997, **40**, 139–170.
22. MAHAJAN A., *Supratrochlear foramen; Study of humerus in North Indians*, Professional Medical Journal, 2011, **18** (1), 128–132.
23. MASNICOVÁ S., BEŇUŠ R., Developmental *Anomalies in Skeletal Remains from the Great Moravia and Middle Ages Cemeteries at Devin (Slovakia)*, International Journal of Osteoarchaeology, 2003, **13**, 266–274.
24. MAYS S., *The archaeology of human bones*, Routledge, London, 1998.
25. ORTNER D.J. *Identification of Pathological Conditions in Human Skeletal Remains*, Elsevier Academic Press, 2003.
26. ROBERTS C., MANCHESTER K., *The Archaeology of Disease*, Third Edition, Sutton Publishing Limited, United Kingdom, 2005, 338 p.
27. SATINOFF M.I., *Study of the squatting facets of the talus and tibia in ancient Egyptians*, *Journal of Human Evolution*, 1972, **1** (2), 209–212.
28. SINGHAL S., RAO V., *Supratrochlear foramen of the humerus*, Anatomical Science International, 2007, **82**, 105–107.
29. SCHAEFER M., BLACK S., SCHEUER L., *Juvenile osteology*, Elsevier Academic Press, 2009.
30. SKRZAT J., WALOCHA J. and ZAWILIŃSKI J., *A note on the morphology of the metopic suture in the human skull*, Folia Morphologica, 2004, **63** (4), 481–484.
31. STUART-MACADAM P., *Porotic Hyperostosis: A New Perspective*, American Journal of Physical Anthropology, 1992, **87**, 39–47.
32. PAINE R.R., MANCINELLI D., RUGGIERI M. and COPPA A., *Cranial Trauma in Iron Age Samnite Agriculturists, Alfedena, Italy: Implications for Biocultural and Economic Stress*, American Journal of Physical Anthropology, 2007, **132**, 48–58.
33. TULSI R.S., PRASADA RAO P.D., *Ilio-tibial facet of the tibia in the Australian Aborigine,* Archaeology & Physical Anthropology in Oceania, 1968, **3**, 232–235.
34. UBELAKER D.H., *Human Skeletal Remains: Excavation, Analysis and Interpretation*, Smithsonian Institute Press, Washington, 1979.

35. VERCELLOTTI G., CARAMELLA D., FORMICOLA V., FORNACIARI G. and LARSEN C.S., *Porotic Hyperostosis in a Late Upper Palaeolithic Skeleton (Villabruna 1, Italy)*, International Journal of Osteoarchaeology, 2009, **20** (3), 358–368.
36. WALDRON T., *Palaeopathology*, Cambridge University Press, 2009.
37. WALKER P.L., *A bioarchaeological perspective on the history of violence*, Annual Revue of Anthropology, 2001, **30**, 573–596.
38. WALKER P.L., BATHURST R.R., RICHMAN R., GJERDRUM T. and ANDRUSHKO V.A., *The Causes of Porotic Hyperostosis and Cribra Orbitalia: A Reappraisal of the Iron-Deficiency-Anemia Hypothesis*, American Journal of Physical Anthropology, 2009, **139**,109–125.
39. WALRATH D.E., TURNER P. and BRUZEK J., *Reliability test of the visual assessment of cranial traits for sex determination*, American Journal of Physical Anthropology, 2004, **125**, 132–137.
40. WAPLER U., CRUBEZY E. and SCHULTZ M., *Is cribra orbitalia synonymous with anemia? Analysis and interpretation of cranial pathology in Sudan*, American Journal of Physical Anthropology, 2004, **123** (4), 333–339.
41. WEINZWEIG J., KIRSCHNER R.E., FARLEY A., REISS P., HUNTER J., WHITAKER L.A. and BARTLETT S.P., *Metopic synostosis: Defining the temporal sequence of normal suture fusion and differentiating it from synostosis on the basis of computed tomography images*, Plastic and Reconstructive Surgery, 2003, **112**, 1211–1218.
42. WINDHAM G.C., BJERKEDAL T., *Secular trends of neural tube defects by demographic subgroups in Norwa*, NIHP Annals, 1982, **5**, 57–67.
43. ZIMMERMAN M.R., KELLEY M.A., *Atlas of Human Paleopathology*, F.A. Praeger, New York, 1982.